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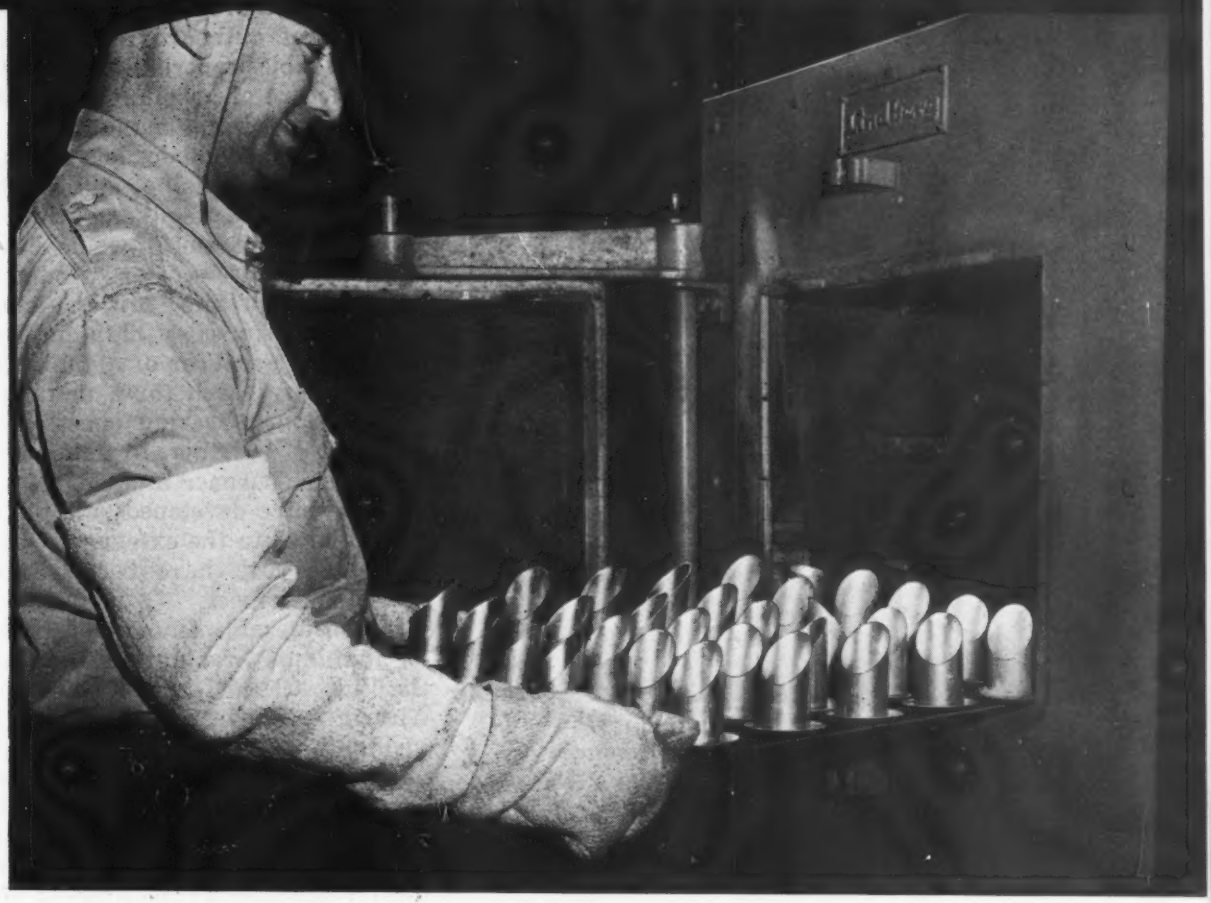

ALUMINUM BRAZING

Cost Savings Bordering on the Spectacular are Possible through the Application of Brazing to Aluminum — a Practice that has been Successfully Applied on a High-Production Basis during the War

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THE manufacturer of products involving the assembly of components fabricated from aluminum or magnesium cannot afford to overlook the potentialities of any method that may serve to reduce costs. The purpose of this article is to disseminate information that has been accumulated relative to the process of aluminum brazing. While a wealth of information covering the brazing of ferrous metals has been published, and the art has had extensive adoption, the brazing of the lighter weight metals such as aluminum and magnesium has been applied by only a few manufacturers, and very little information has been published concerning this phase of brazing. It is not suggested that the brazing of alu-

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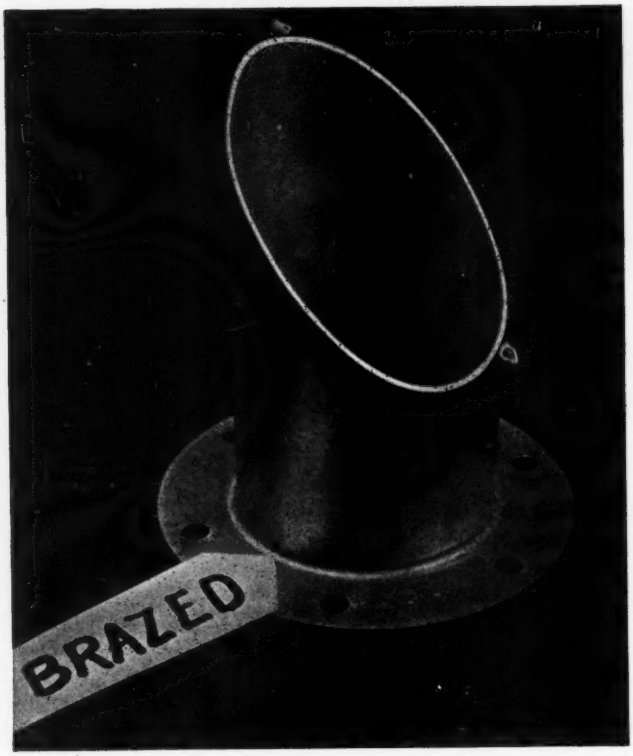


Fig. 1. Flanged Tube Assembly Produced by Brazing at the Rate of 100 Parts in Eighteen Minutes, whereas the Same Number of Parts Originally Required 1.8 Hours when Gas-welded

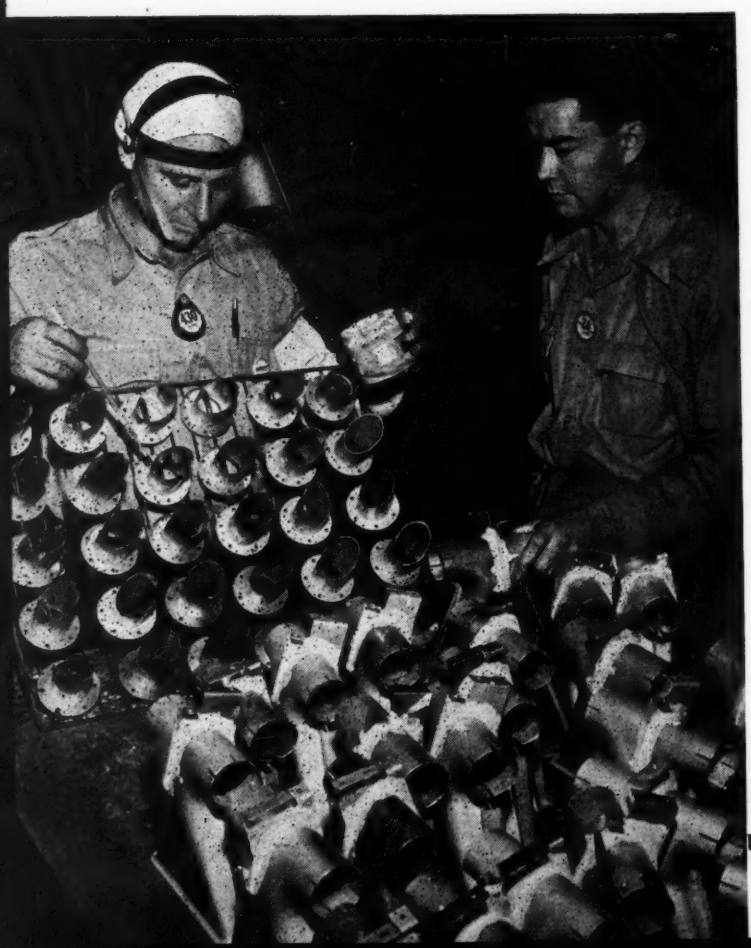


Fig. 2. Painting Flux around Aluminum Pieces to be Joined by Brazing prior to Placing Them in Furnace Shown in Heading Illustration

minum is new, or that high-production application has not been effected. An eastern manufacturer of outboard motors has made highly commendable contributions to the art in the manufacture of gasoline tanks. A midwest concern engaged in the manufacture of inter-coolers used in heavy bombers has designed his product for aluminum brazing, and has been using this joining method for some time. The cost of welding this assembly would have been prohibitive. The inter-cooler production line built around the brazing process is an outstanding example of low-cost, high-quality assembly.

A major producer of aluminum has been conducting a research for a number of years, and has developed brazing sheet, alloys, materials, and fluxes suitable for immediate successful adoption. Furnace and flux pot manufacturers likewise have developed suitable equipment and "know-how" to the extent that the uncertainties and guesswork have been removed from the equipment aspect.

A considerable amount of experimental work on aluminum brazing has been accomplished at the Vultee Field Division of Consolidated Vultee Aircraft Corporation. In addition, a "pilot" installation provided with a small furnace was used in actual production for several months. The results were so gratifying that plans were made for a relatively large installation, the redesign of certain units for brazing, and an extensive adoption of the process. However, recent production schedule cut-backs have made it advisable to delay this program. It therefore appears best to release to industry in general such information as has been gleaned up to this time, in order that those who are interested may use the process where applicable. An idea of the potential economies may be obtained from the cost comparisons to be given here.

Let there be no implication that brazing is to entirely supplant riveting, welding, metal bonding, or other joining methods. However, there are countless instances in which brazing can be, and should be, substituted for current methods; in many cases, the cost savings would border on the spectacular.

For example, Fig. 1 shows a flange tube assembly which was oxy-acetylene welded at the rate of 100 parts per 1.8 hours. The same number of pieces were brazed in eighteen minutes. The flange of this assembly was blanked and pierced from brazing sheet, an aluminum alloy having

Fig. 3. Magneto Blast Tube Assembly on which Production Rate is 100 Parts in Twelve Hours when Gas-welded and 100 Parts in Fourteen Minutes when Brazed

a coating of filler material that is applied in a manner similar to that followed in the production of Alclad. A simple assembly fixture was used to locate the baffle of the tube in proper relationship with the hole in the flange.

Fig. 3 shows a magneto blast tube assembly which was previously gas-welded at the rate of 100 parts per twelve hours. The same quantity of work was brazed within fourteen minutes. The parts were assembled prior to joining by the use of a simple fixture which insured proper location. The tube was held at a low temperature in dry ice preparatory to assembly in order to facilitate the assembly operation. The filler material consisted of 43-S wire, 1/16 inch in diameter. It was formed into a ring and slipped over the tube into a position adjacent to the flange prior to heating.

Manufacturers should attain sufficient familiarity with aluminum brazing to know where and where not to use it. Engineers should know how to create new product designs, and how to modify existing designs in order that the advantages of the process can be realized. Proper equipment and adequate control and maintenance are necessary. The supervisory personnel and workers should be properly trained, although this is not as difficult as the teaching of correct welding methods.

Brazing differs from welding in that the temperatures used are slightly below the melting point of the metals being joined, and slightly above the melting point of the filler metal that makes the joint. Very little, if any, of the parent metal is melted. Welding, by comparison, involves temperatures sufficient to melt substantial portions of the parent metal adjacent to the joint, causing it to flow and alloy with the filler metal. The principal difference between brazing and soldering is that the former requires higher temperatures, which allows the use of filler metal of greater strength.

A comparison of aluminum brazing with the

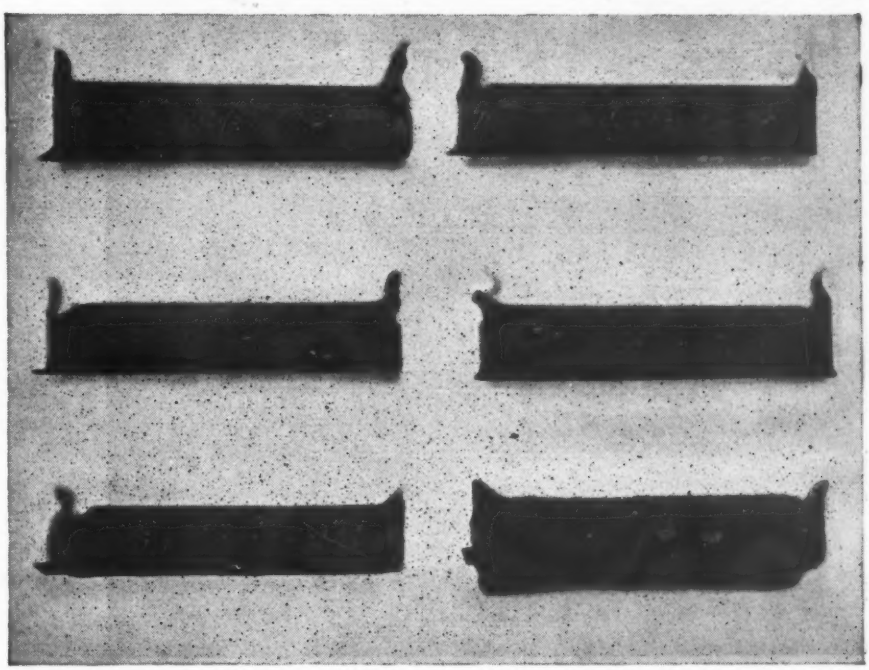


Fig. 4. A Radiograph of Brazed Joints Showing How Flux was Entrapped because of Improper Joint Design between the Parts Assembled

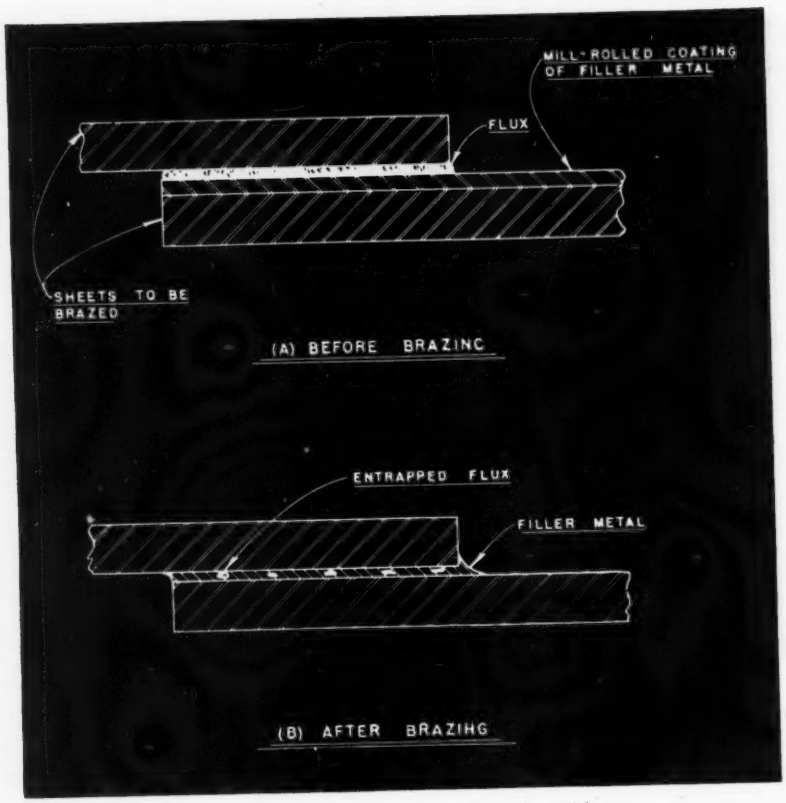


Fig. 5. Diagrams which Show How the Entrapment of Flux Occurs when Joints to be Brazed are Prepared in the Conventional Manner

brazing of steels or other ferrous metals will show that the fundamental difference is that the filler metal for aluminum is of a similar alloy to aluminum, whereas usually a different alloy, such as copper or silver, is used for the ferrous materials. Also, the temperature ranges are lower for the former. Furthermore, no definite space between parts to be joined, or a press fit, is required in brazing steel parts together, whereas controlled spacing has been found necessary for the successful brazing of aluminum alloys.

Aluminum brazing may be divided into the three processes of torch brazing, furnace brazing, and flux dip brazing. Torch brazing, as the name implies, is accomplished by heating the juxtaposed parts with a torch and applying the filler metal in the form of a wire, in a manner similar to that employed in welding. This article will be confined to the second and third methods referred to.

Furnace brazing involves the mechanical assembly of the parts in their required relation to each other, followed by the application of flux over the joint areas by spraying, or with a brush. Fig. 2 shows the brush method of application. The filler metal may be applied in the form of a wire secured adjacent to the joints, as metal sprayed over the joint, or in the form of a thin coating that has been mill-rolled over either one or both surfaces of the stock from which one or both of the parts to be joined has been produced. The

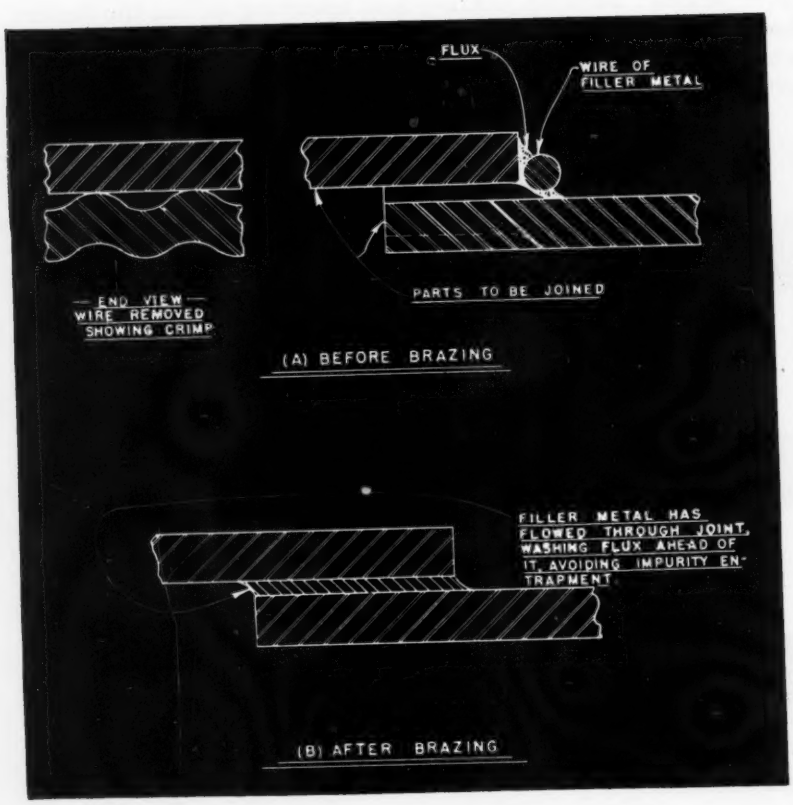

FLUX
WIRE OF FILLER METAL
END VIEW WIRE REMOVED SHOWING CRIMP
PARTS TO BE JOINED
(A) BEFORE BRAZING
FILLER METAL HAS FLOWED THROUGH JOINT, WASHING FLUX AHEAD OF IT, AVOIDING IMPURITY ENTRAPMENT
(B) AFTER BRAZING

Fig. 6. Diagrams which Indicate the Flushing Action of the Flux that is Obtained when the Joint between the Parts to be Brazed is of Corrugated Construction

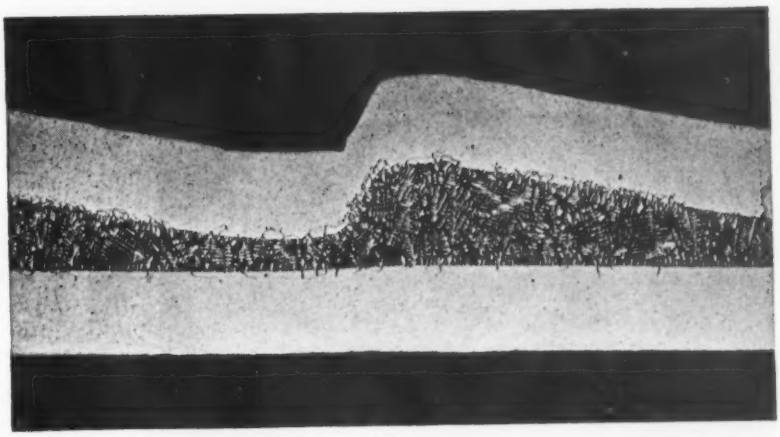


Fig. 7. Photomicrograph of a Brazed Corrugated Joint which Indicates the Freedom from Flux Inclusion Obtainable with that Type of Joint

furnace should be capable of adjustment within very close limits throughout all portions of the heated chamber.

The parts to be brazed are usually placed in racks to carry them into the furnace. The racks may be constructed of corrosion-resistant steel wire or strips, as in the case of the rack being used in the heading illustration. They should be made as light in weight as possible, in order to facilitate handling and to reduce furnace temperature drop and heat loss following work removal.

The work is held in the furnace only a few minutes, merely long enough to bring the parts up to temperature, as the filler metal will then melt and rapidly flow through the joints. Upon removal from the furnace, the parts may be quenched in water, thus concurrently completing heat-treatment for some alloys, or they may be allowed to cool naturally in the open air.

Flux dip brazing involves the use of a pot of hot molten flux as a heating agent in which the assembly to be brazed is immersed. Several important advantages over the furnace method result. For example, the necessity of applying flux to the assembly is eliminated. The flux prevents surface oxidation within the joint areas, and further serves to "wet" the surfaces over which the filler metal flows, thus providing a favorable capillary condition.

The transfer of heat to the work is quicker and more uniform, resulting in less distortion due to uneven heating. As the specific gravity of the bath is high, the melting filler metal is buoyantly supported, reducing difficulties which occasionally occur due to gravity drainage. The importance of rapidly and uniformly heating all parts should not be underestimated. Different sections of enclosed or semi-enclosed assemblies constructed of thin sheet metal may, because of mass relationships, approach oven temperature at different times. Parts which heat more rapidly may draw or distort away from the slower heating parts due to their quicker thermal expansion. Thus, the proper positioning is lost. Parts may, if restrained, develop buckles or distortion within themselves.

Gravity drainage of molten filler metal, sometimes experienced in furnace brazing, is almost entirely eliminated by the flux dip method. Due to the very slight difference between the melting

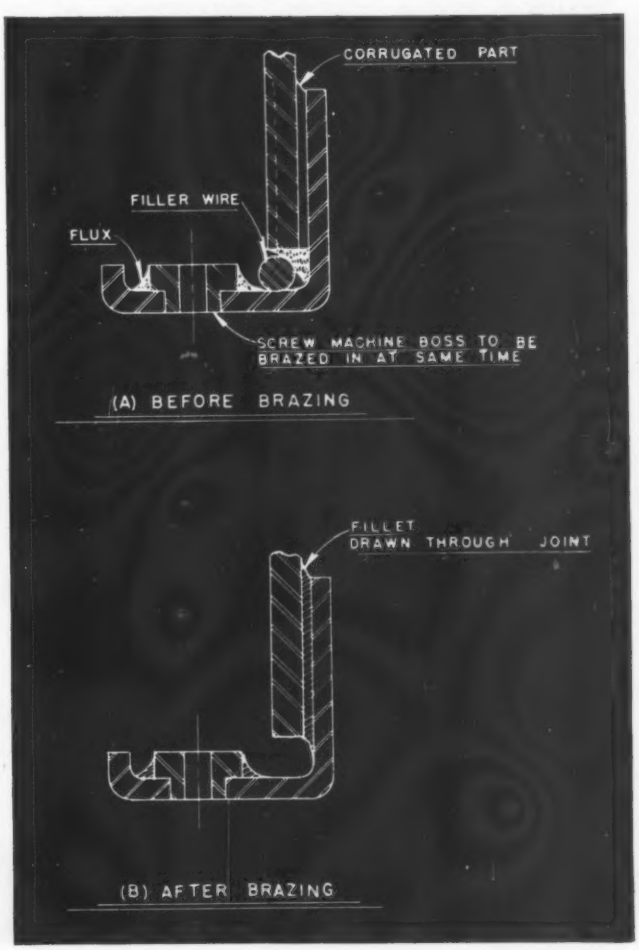


Fig. 8. Diagrams which Show a Brazing Operation in which an Internally Corrugated Part is Brazed to a Cylindrical Flange, and at the Same Time, Bosses Produced on a Screw Machine are Brazed to the Flange

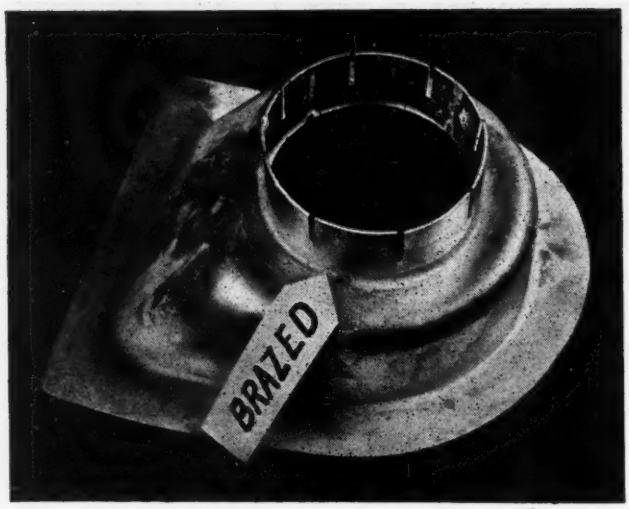


Fig. 9. Brazed Aluminum Assembly Made up from a Stamping and a Rolled Component in which Slots were Cut Preparatory to the Rolling Operation

points of the filler and parent metals, a few degrees variance of the temperatures in different parts of the furnace, which is usually experienced in production, will result in excessive fluidity of the filler metal in the hotter portions. The extent of this fluidity may be such that the filler metal will run into and out of the joint, leaving it with a "starved" appearance. At the same time, work in the cooler portions of the furnace, usually near the corners, will develop lumpy or puddled joints, because the filler metal was not heated sufficiently to allow a proper flow, or it was heated so slowly that, according to one theory, some of its alloying constituents flowed away first, leaving the remainder a skeleton outline of the original wire.

In general, the flux dip method is preferable for all assemblies that lend themselves to flux drainage after removal from the pot. The production time is usually substantially less, as the heat transfer is more rapid than in air. The flux pot consists of a suitable corrosion-resistant container for the molten flux, and is electrically heated. The required size depends upon the size of the work and the desired production rate. It may prove advisable to provide a mechanical dipper, operated by a mechanism that maintains a uniform work movement velocity, in order to avoid shaking the molten filler metal from the parts when they are removed from the bath.

A preheating chamber or bath is advisable with the flux dip method, and provisions should be made to recover flux so as to reduce dragout losses. Cleaning tanks, before and after brazing, are necessary.

Aluminum alloys suitable for brazing include 2S, 3S, 61S, and a number of special alloys developed by the Aluminum Company of America. Alloys 2S and 3S cannot be heat-treated and lose any work-hardened properties they may have possessed due to the annealing effect of the brazing process. Alloy 61S may be heat-treated following brazing. The strength of this alloy is increased materially if the part is quenched in cold water immediately following the brazing operation. The brazing time involved is not more than that required for the solution heat-treatment alone.

Brazing inherently possesses the same difficulties of inspection as welding, in that a good surface appearance does not necessarily guarantee fusion soundness throughout the brazed section. Until recently, there seemed to be no method of process control sufficiently exacting to insure joints free from inclusions of foreign matter. Hence, safety factors including an ignorance increment were necessarily high. Perhaps the most valuable contribution of

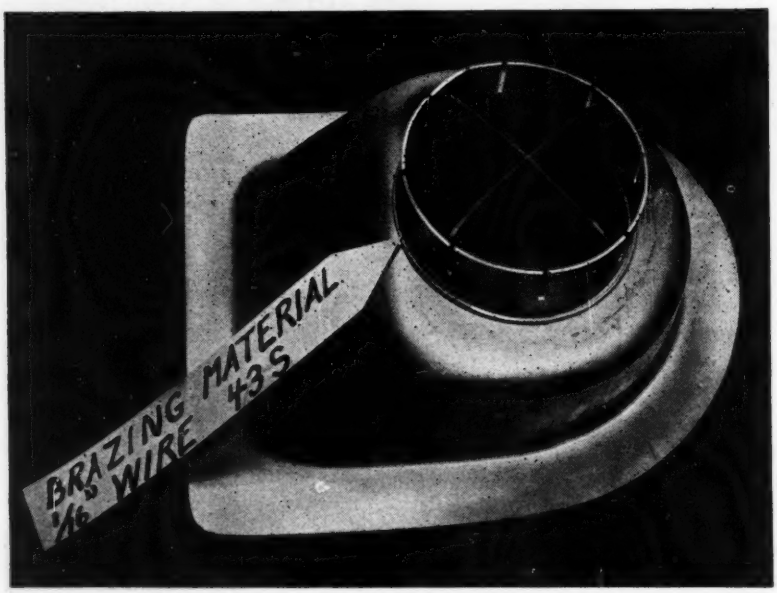


Fig. 10. Illustration which Shows How the Components of the Part in Fig. 9 were Held in Proper Relative Positions by Stainless-steel Clips for the Brazing Operation

Fig. 11. Air Dispenser Assembly Made up of Two Stampings which were Welded at the Rate of 100 Parts in Twenty Hours. The Parts can be Brazed at the Rate of 100 Parts in One Hour

this article is the publicizing of methods developed by the Vultee Field Division of the Consolidated Vultee Aircraft Corporation which appear to have overcome this obstacle.

Heretofore, brazing has essentially consisted of providing a crevice between the parts to be joined, and placing adjacent the alloy of lower melting point which, when heated, was expected to seal the crevice and fill it by capillary action. Obviously, the necessary flux and any included impurities would be washed ahead of the flow of molten metal and would be trapped in the innermost portions of the area to be filled. Such practice resulted in two detrimental effects: First, a loss of joint area of unknown magnitude, and, second, the ensuing corrosive action of such entrapments—the second naturally being of primary importance in aircraft structures, in which the safety factor element predominates. The diagrams in Fig. 5 illustrate how flux may be entrapped, while Fig. 4 shows radiographs of brazed sections, in which the lighter portions indicate cavities containing highly corrosive flux.

The "Vultee Field" solution to this problem is as simple as it is effective. By means of a mechanical design, a back door is provided in the joint to be brazed, which allows the molten filler metal to flow completely through the joint, washing all impurities ahead of it and forming a fillet across the exit. Visual inspection of the fillet thus formed reveals that the molten metal has flowed completely through the joint, that no entrapments have been formed, and that no loss of brazed area has resulted.

Engineers experienced in the brazing of ferrous metals know that no space need be allowed between the parts to be joined; in fact, press fits with considerable metal interference make excellent assemblies for ferrous brazing. However, lighter metals definitely require a separation, and brazing cannot be accomplished unless the dimensions of the space between parts are accurately controlled. This is necessary, among other reasons, because of the higher viscosity of molten aluminum as compared with molten copper alloys, and because of the higher surface tension, necessitating a different capillary condition. Actually, the separation required should be between 0.010 and 0.030 inch.

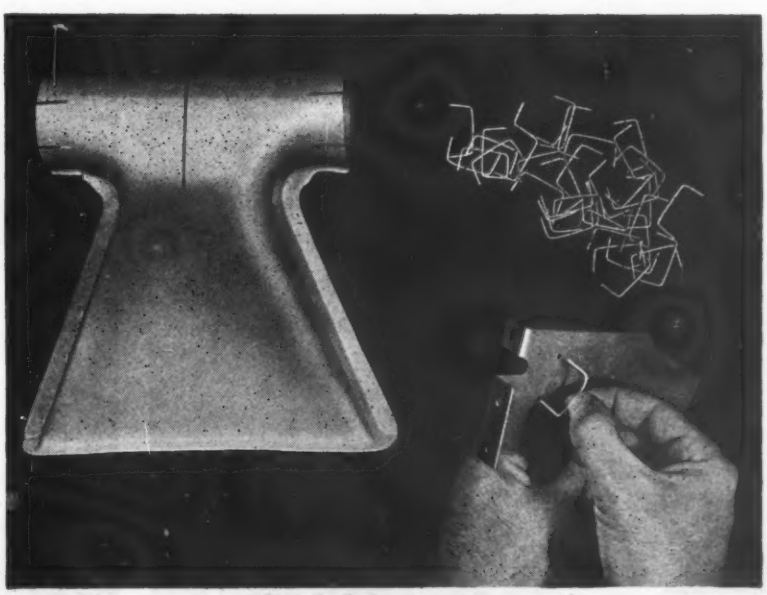


Fig. 12. The Brazing Material Required for the Assembly in Fig. 11 Consists of a Simple Clip, which is Merely Inserted through Two Pierced Holes in the Baffle

Fig. 13. Brazed Assembly in which Bosses Produced on Screw Machines are Attached to a Flange at the Same Time that the Flange and Duct are Brazed Together

The problem of assembling two parts together and at the same time maintaining sufficient dimensional accuracy to insure proper spacing, as in the case of two parts formed from sheet metal, has been effectively overcome by a process of crimping or corrugating one of the surfaces to be joined. This method is shown in Figs. 6 and 8. Diagram *B* in Fig. 6 also indicates the freedom from flux entrapment that results from such a construction, and Fig. 7 shows a photomicrograph of a brazed corrugated joint free from flux inclusion. The corrugated construction allows press fits of circular, contoured, or square structures, which may be tack-riveted, tack-welded, metal-stapled, or secured by other means of mechanical assembly prior to performing the brazing operation.

Not all joining must be of corrugated construction in order to acquire certain production acceptance. For example, as already pointed out, the assembly in Fig. 1 consisted of a tube and a stamped flange. The flange was blanked from sheet stock and required a light coating of brazing metal. Because of the nature of the assembly, particularly the joint distance, which was equal to the flange thickness plus two brazed fillets, any danger of flux entrapment was precluded.

It is believed by the author that brazing of both aluminum and magnesium alloys will be widely adopted because of the anticipated necessity of close cost control in order to successfully engage in the competitive fields of post-war manufacture. If manufacturers adopt the process conservatively at the start, extremely satisfying and highly potential results can be expected from such a procedure. If possible, plants having commercial installations should first be visited and studied. In any event, "pilot" experiments should be conducted with simple equipment before an elaborate set-up is planned.

Fig. 14. Close-up View of the Brazed Joint on the Duct Assembly in Fig. 13. The Fillet was Formed by the Molten Metal Drawn through the Joint Area by Capillary Flow

Fig. 15. Duct Produced Entirely by Brazing from the Stampings and Screw Machine Parts Illustrated in Fig. 20 at a Saving of $3 per Assembly over the Welded Product in Fig. 17

Fig. 16. Prior to Development of Brazed Assembly in Fig. 13, This Unit was Riveted as Here Shown, Requiring a Heavy Formed Ring for Reinforcement of the Flange

The remainder of this article will deal with additional examples of brazed aluminum work. In Fig. 9, for example, is shown an oil-tank filler neck pan which was previously produced by gas-welding at the rate of 100 parts per eight hours. By brazing, 100 parts are produced in forty minutes. The part was brazed in order to eliminate additional drawing operations that would have been necessary to obtain the required depth. Brazing also enabled the extension at the upper end to be slotted as a flat strip and then rolled. The pieces that make up this part were assembled as shown in Fig. 10. It will be noted that stainless-steel locating clips were employed to hold the components in the proper relative positions.

The air dispenser assembly illustrated in Fig. 11 consists of two stampings, one of which has been both stamped and folded. The baffle, which fits into a narrow slot in the principal member, is located by a tongue bearing against the interior of the large part. The bottom of the slot controls the height of the flanged portions of the baffle above the assembly. Fig. 12 illustrates the method of providing brazing material for this operation. Brazing material in the form of a clip is merely inserted through two pierced holes in the baffle. When these air dispensers were assembled by welding, the production time was 100 parts per twenty hours. One hundred parts can be brazed within one hour.

Fig. 13 shows a good example of corrugated construction. The circular flange is a simple stamping that is reinforced for bolt attachment by bosses produced on an automatic screw machine. Brazing of these bosses to the flange was accomplished at the same time as the joining of the flange to the duct stamping by brazing. The tack rivets seen in this illustration were omitted in subsequent production. Fig. 16

Fig. 17. When the Duct Shown in Fig. 15 was Riveted and Welded, Heavy Flat Strips of Aluminum were Required for Flange Reinforcement as Here Illustrated

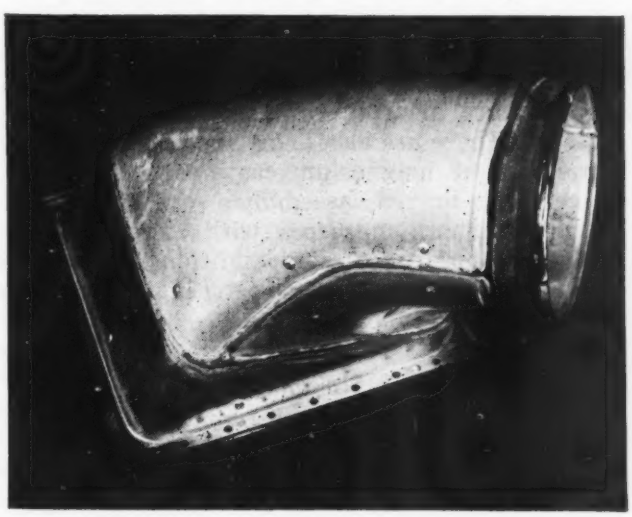


Fig. 18. Internal Fins in the Duct in Fig. 15 were Also Brazed in Place as Here Illustrated, whereas in the Duct in Fig. 17 They were Riveted in Place

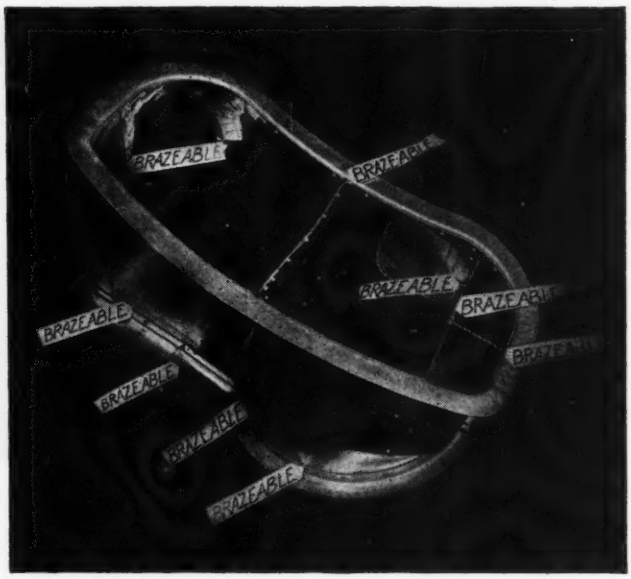


Fig. 19. Riveted Aluminum Assembly which could be Materially Improved in Appearance and Produced at an Appreciable Saving in Cost if Constructed by Brazing in Place of Riveting

shows how this assembly was previously made by riveting. It will be seen that the flange was reinforced by a heavy formed ring, and rivets were required to fasten the flange to the duct stamping. In Fig. 14 is presented a close-up view of the braze made to hold the flange to the duct stamping when this assembly is made as shown in Fig. 13. The fillet was formed by the molten material after it was drawn through the joint area by capillary flow. This illustration also shows the method of corrugating the outer member in order to mechanically provide a spacing that will create a favorable capillary condition and facilitate a tightly fitting assembly prior to brazing.

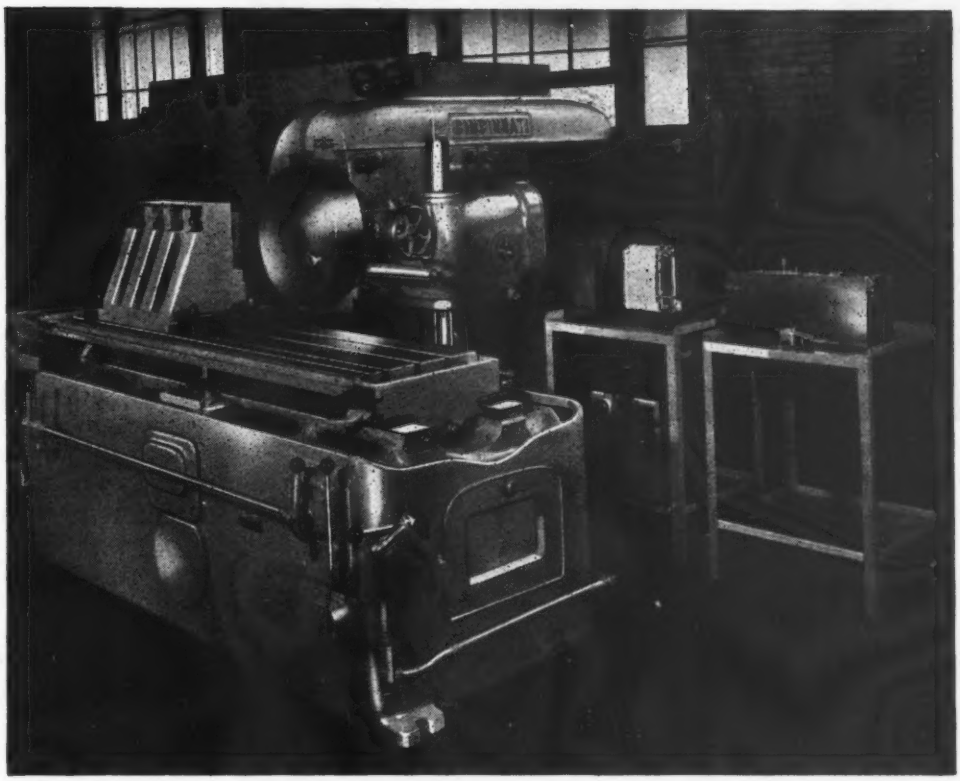
In Fig. 15 is shown an assembly that was furnace brazed on an experimental basis to determine the cost in comparison with the welded and riveted construction shown in Fig. 17. By brazing, a saving of $3 was effected per assembly. The duct body was stamped in two halves for brazing and the lap joints were tack-riveted. The square flange is a single stamping and was also tack-riveted to the assembly prior to brazing. Again the bosses are screw machine products that were inserted in holes pierced through the flange. Each boss was made with a turned shoulder to control the height above the flange. The assembly contained internal deflecting fins, as shown in Fig. 18, which were also rolled stampings brazed in place. This constituted an ideal assembly for flux dip brazing. In Fig. 20 are seen the various stampings and screw-machine turned inserts required for the brazed assembly.

Fig. 17 clearly shows the former riveted and gas-welded design. Heavy flat aluminum strips were required to reinforce the flange. The internal deflecting fins were also riveted in place.

In Fig. 19 is shown a rather complicated riveted sheet-metal assembly which could be assembled by brazing at a large number of points, as indicated. Extensive savings could be effected and a more pleasing construction obtained by brazing. There are also many instances in which aluminum or magnesium castings could be replaced by brazed assemblies constructed of stamped aluminum pieces with a very appreciable saving in cost. In addition, weight reductions of as much as 50 per cent could often be achieved in this way.

Fig. 20. Five Stampings and Thirty-five Bosses Produced on Screw Machines that are Required for the Brazed Duct Assembly Shown in Fig. 15

Milling Cast Iron with Carbide Cutters



At a Recent Meeting of the American Society of Mechanical Engineers, Michael Field, Research Fellow, and W. E. Bullock, Assistant Professor of Mechanical Engineering at the University of Cincinnati, Described the Results Obtained to Date in a Long-Range Research Project to Determine the Interrelationship of Tooth Design, Cutting Speed, Feed per Tooth, Type of Cast Iron, Tool Life, Power Required, and Cost of Milling. These Results are Here Summarized

CAST iron and other cast ferrous alloys have been milled with carbide-tipped cutters in commercial practice for more than ten years. The cutting speeds generally employed have ranged from 150 to 300 feet per minute with a feed per tooth varying from 0.003 to 0.008 inch, and with rake angles ranging from zero to 10 degrees positive. During the past few years, an increasing percentage of all machining of iron castings has been performed with carbide-tipped cutters.

In order to accelerate progress in this field by investigating new combinations of tooth angles and cutting speeds, and to explore further the fundamental relationships involved in metal cutting, a research project of broad scope was undertaken at the University of Cincinnati. Throughout the progress of this research, close cooperation was maintained with the Cincinnati Milling Machine Co. so as to apply, wherever possible, the results of previously undertaken research and to provide an interchange of scientific knowledge, technical experience, and research facilities.

A survey of previous research showed that in spite of all the years of experience in milling cast iron with carbide cutters there were few, if any, quantitative data available on the inter-

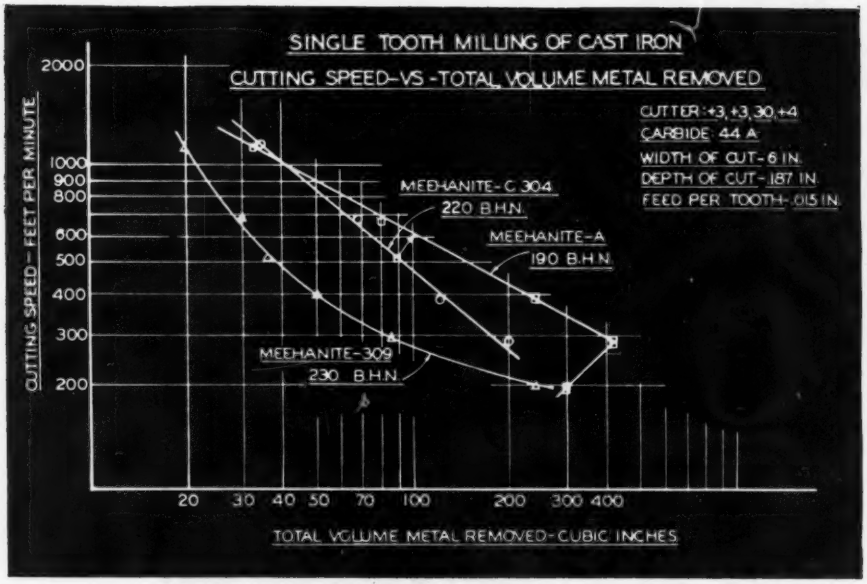


Fig. 1. Chart Indicating the Relationship between Cutting Speed and Tool Life in Terms of Volume of Metal Removed for Three Types of Meehanite Cast Iron

relationship of tool life, finish, and cost of milling with such factors as feeds and speeds, tooth angles, depth and width of cut, and metallurgical structure. The primary object of the initial phase of the research work at the University of Cincinnati, therefore, was to investigate the factors basically involved in the milling of cast iron and to obtain quantitative data on these factors. The present article is a summary of the results obtained in so far as these results directly affect machine shop practice.

Types of Cast Iron Milled and Scope of Investigation

Three grades of Meehanite were used in these tests, the physical characteristics and compositions of which are given in the accompanying table. Meehanite A had a Brinell hardness of 190; Meehanite C-304 and C-309 were standard Meehanite C iron with alloy additions, as may be noted from the table. The hardness of these two grades was 220 and 230 Brinell, respectively.

From a production standpoint, the most important subject in any metal-cutting investigation is tool life. Tool life can be judged by several criteria: (1) Actual cutting time to dull one tooth; (2) number of chips to dull one tooth; (3) total length traveled by tooth; (4) total volume of metal removed per tooth; and (5) cubic inches of metal removed per inch of cutting edge per tooth.

The most significant of these from the standpoint of practical operation is the volume of metal removed per tooth, as this gives the most direct indication of the number of parts that can be milled before the cutter has to be resharpened. However, it is possible to compute all the other criteria from the volume of metal removed per tooth.

To study the factors that affect the tool life, two widely different cutters and three types of material were initially chosen. The cutting speed was varied over a range of from 200 to 1575 feet per minute, and the feed per tooth over a range of from 0.005 to 0.065 inch. In addition to the tool life, the surface finish, work breakout, and power were measured.

Some of the Results on Tool Life Obtained from the Experiments

In examining the relation between cutting speed and tool life, measured in terms of volume of metal removed, it was recorded that the tool life in general increases as the cutting speed is reduced. Fig. 1 shows the results obtained at 0.015 inch feed per tooth using a cutter with a 3-degree positive axial rake, 3-degree positive

Chemical and Physical Properties of Types of Material Used in Milling Tests

Properties and Composition	Meehanite		
	"A"	"C-304"	"C-309"
Average Brinell hardness	190	220	230
Tensile strength, pounds per square inch (1.2-inch arbitration bar)	50,000	45,000	40,000
Total carbon, per cent	2.85–3.15	2.90–3.20	2.90–3.20
Silicon, per cent	1.20–1.50	2.45–3.00	1.60–1.85
Phosphorus, per cent.	0.12 Max.	0.18 Max.	0.18 Max.
Sulphur, per cent	0.20 Max.	0.20 Max.	0.20 Max.
Manganese, per cent.	0.8–1.2	0.75–1.00	0.75–1.00
Chromium, per cent.	—	1.00	1.25
Copper, per cent	—	—	3.00
Molybdenum, per cent	—	0.50	—

radial rake, 30-degree corner angle, and a resultant or true rake of 4 degrees positive. For simplicity, these angle specifications may be abbreviated to read + 3, + 3, 30, + 4. The clearance ground on all of the edges was 7 degrees. In the early tests, it was found that this cutter broke down prematurely at the tooth point—the intersection of the peripheral and face cutting edges. A 60-degree chamfer, 1/16 inch wide, was then ground at the point; this prevented an early breakdown. Cutters with the tooth angles specified are regularly used in industry today for milling cast iron.

From Fig. 1 it is evident that there is a characteristic curve for each type of Meehanite. These curves are not all straight lines when plotted on log-log paper. They may be either straight or curved, depending on the material and the cutting conditions. It will be noted that there is a wide divergence in the total volume of metal removed during the life of the tool at 300 feet per minute, while at 200 feet per minute all the curves tend to converge. The immediate conclusion is that it is not correct to compare relative machinability of cast irons at a single cutting speed.

A second observation is that there may be an optimum cutting speed where the largest volume of metal is removed during the life of the tool. This optimum speed is about 300 feet per minute for Meehanite A. It seems likely that the optimum speed is lower for the harder materials—such as Meehanite C-304 and C-309—although this is not indicated by the tests, since they did not go below 210 feet per minute. The cutter with which the preceding tests were performed will be designated as R6.

Additional experiments were performed with an entirely different type of cutter. This cutter, which will be referred to as cutter R8, has a positive axial rake of 15 degrees, a negative radial rake of 30 degrees, a 75-degree corner angle, a resultant or true positive rake of 6 degrees, and a positive "angle of inclination" of 32 degrees. The "angle of inclination" is the angle between the cutting edge and a plane normal to the path of motion.

The large corner angle makes it possible to take a high feed per tooth without a correspondingly heavy chip thickness (see Fig. 2). In addition, the large positive angle of inclination usually provides a gradual engagement of the cutting edge as the tooth enters the work. It also results in a helically curled chip which freely clears the cutter. Figs. 3 and 4 show chips taken by cutters R6 and R8. It will be noted that the radius of chip curl increases with both feed per tooth and cutting speed.

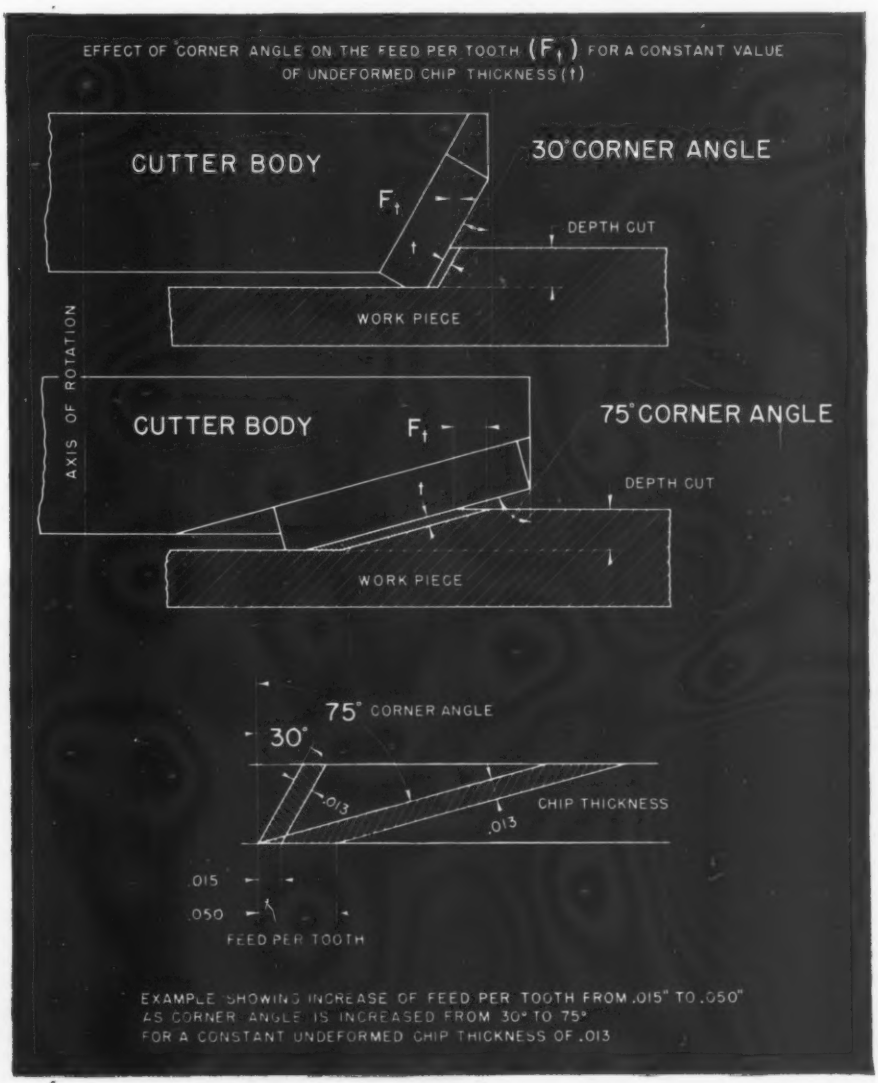

EFFECT OF CORNER ANGLE ON THE FEED PER TOOTH (F_t) FOR A CONSTANT VALUE OF UNDEFORMED CHIP THICKNESS (t)
CUTTER BODY
30° CORNER ANGLE
F_t
DEPTH CUT
WORK PIECE
AXIS OF ROTATION
CUTTER BODY
F_t
75° CORNER ANGLE
DEPTH CUT
WORK PIECE
75° CORNER ANGLE
30°
.013
.013
CHIP THICKNESS
.015
.050
FEED PER TOOTH
EXAMPLE SHOWING INCREASE OF FEED PER TOOTH FROM .015" TO .050" AS CORNER ANGLE IS INCREASED FROM 30° TO 75° FOR A CONSTANT UNDEFORMED CHIP THICKNESS OF .013

Fig. 2. Comparison between Two Types of Cutters, Showing the Importance of a Large Corner Angle

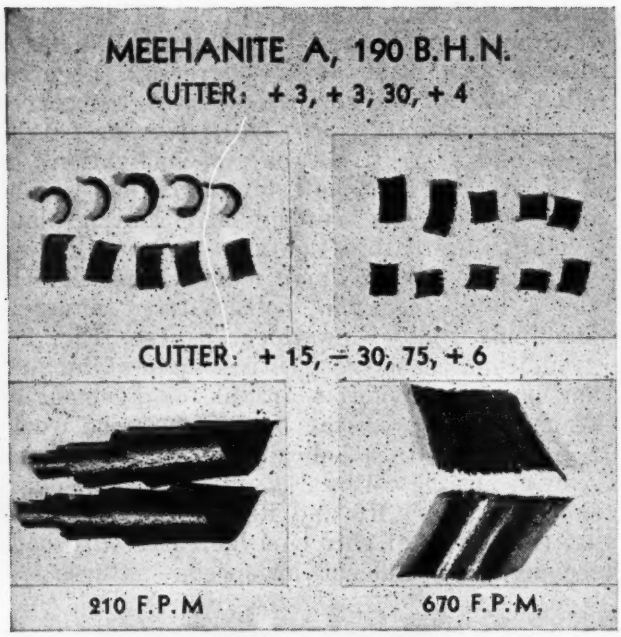


Fig. 3. Chips Made by Two Different Types of Cutters at Different Cutting Speeds. The Chips in the Two Top Views are Made with a Feed of 0.015 Inch per Tooth; the Chips in the Two Bottom Views are Made with a Feed of 0.050 Inch per Tooth

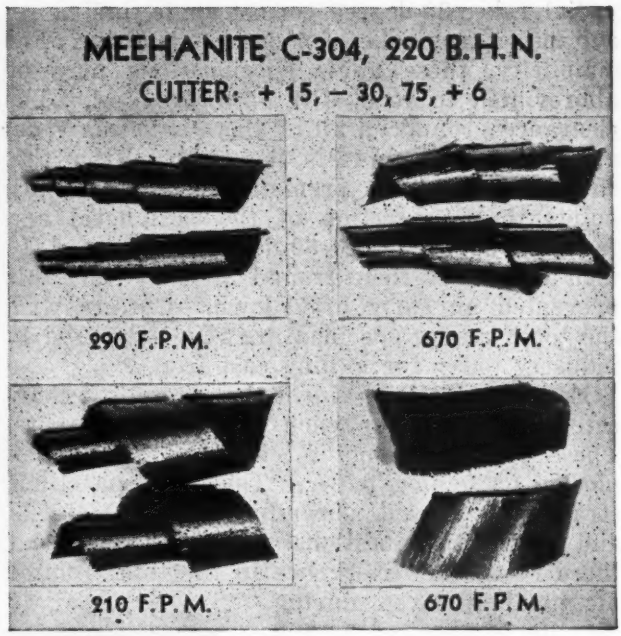


Fig. 4. Chips Made by Cutter R8 at Different Cutting Speeds. The Chips in the Two Top Views are Made with a Feed of 0.020 Inch per Tooth; the Chips in the Two Bottom Views are Made with a Feed of 0.035 Inch per Tooth

The relation between cutting speed and volume of metal removed during the life of the tool with cutter R8 in milling Meehanite A and Meehanite C-304 at 0.050 inch feed per tooth is shown in Fig. 5. The 0.050 inch feed per tooth resulted in a maximum "undeformed chip thickness" of 0.013 inch, which is the same as that obtained with a 30-degree corner angle cutter at a feed per tooth of 0.015 inch. In other words, the 75-degree corner angle cutter can be fed three and one-third times as fast as the 30-degree corner angle cutter to obtain the same undeformed chip thickness. Fig. 5 further shows that more metal is removed at the same speeds from Meehanite A than from Meehanite C-304.

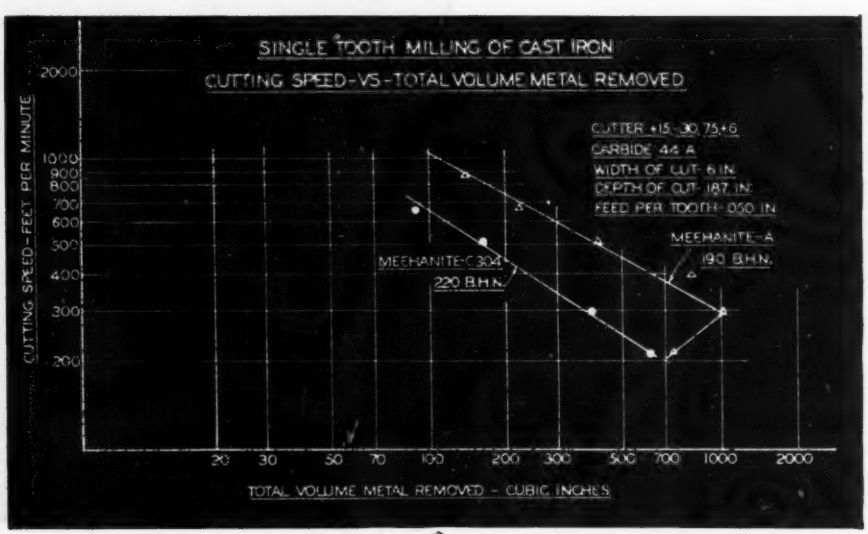


Fig. 5. Chart Showing Effect of Cutter Design on Tool Life. Compare This Chart with Fig. 1

Fig. 6 shows the relation between cutting speed and total volume of metal removed during the life of the tool for the two cutters under investigation. The superiority of the R8 cutter is evident. The total volume of metal removed during the tool life is two and one-half to three times as great for the R8 cutter as for the R6 cutter. In addition, cutter R8 is fed three and

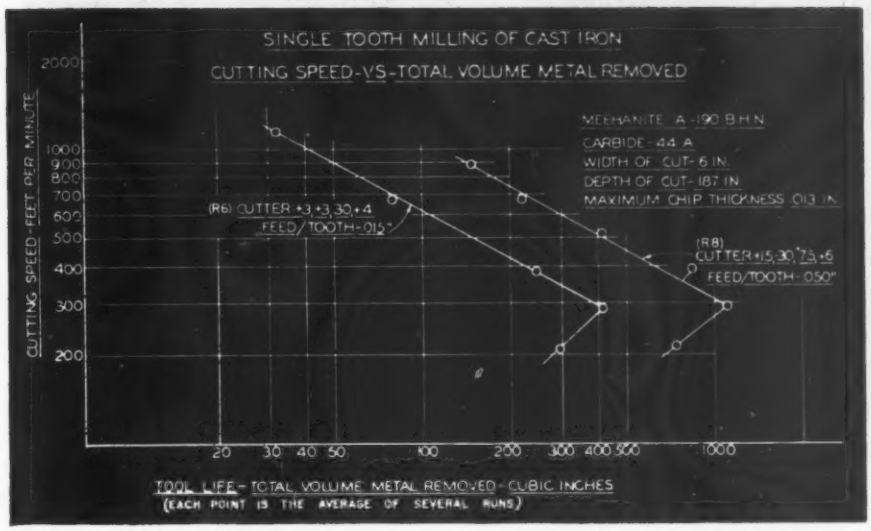


Fig. 6. Comparison of Results Obtained by Two Different Types of Cutters

one-third times as fast. It is of interest to note that the maximum tool life occurs at the same cutting speed for both cutters.

If the relation of cutting speed to the actual *time* required to dull the tooth is compared for both cutters when milling Meehanite A, a misleading impression of tool life may be obtained, as the actual cutting time curves are almost alike, as shown in Fig. 7. The equal time values are due to the fact that while cutter R8 removed about three times as much metal as cutter R6 before dulling, it was fed three times as fast. One must not gain the erroneous impression from this illustration that both cutters performed equally well, because, in reality, cutter R8 would produce three times as many parts before dulling as cutter R6.

A complete understanding of the performance of a tool must take into consideration the feed per tooth as well as the cutting speed. Fig. 8 shows the results of tests made with cutter R8 on Meehanite C-304, plotting cutting speed against total volume of metal removed during the life of the tool at feeds per tooth of from 0.005 up to 0.065 inch. At the high speeds, there was a great decrease in metal removal for the low feeds per tooth. However, at about 200 feet per minute, the curves converge, indicating that the cutter life at this speed is practically independent of the feed per tooth. From this we note that it is possible to cut, with a reasonable tool life, at low feeds per tooth, provided the cutting speed is likewise low. If these curves are replotted to show the volume of metal removed in relation to the feed per tooth, then at all speeds the optimum life occurs at approximately 0.050 inch feed per tooth, or 0.013 inch maximum undeformed chip thickness. This is shown in Fig. 9.

Quality of Surface Finish

The surface finish obtainable was found to be a function of the type of cast iron, the cutting speed, and the length of the "face cutting edge" of the tooth. The finish seemed to be independent of the type of tool and the feed per tooth, provided the length of the face cutting edge was greater than the feed per tooth, so that feed ridges could be avoided. A difference was noted between the appearance of the milled surface and the finish recorded by the Profilometer. The Meehanite A castings had an open porous appearance that gave the impression of a

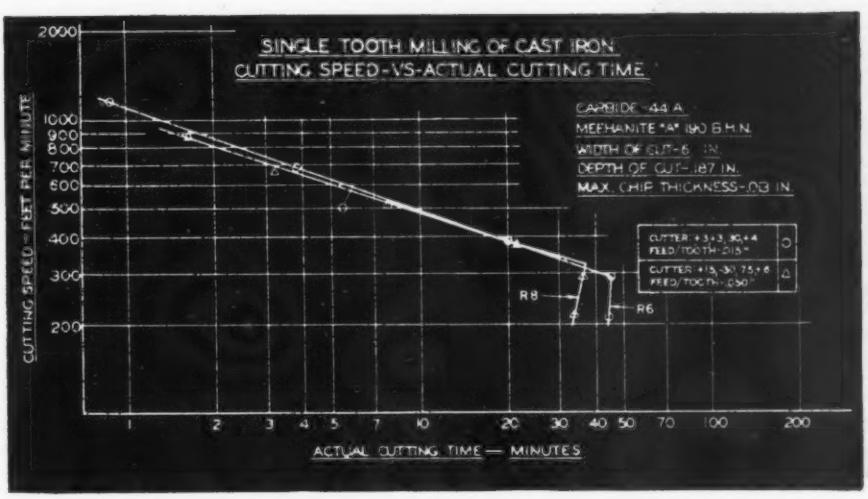


Fig. 7. Curves in Chart May Prove Misleading unless it is Remembered that Cutter R8 Removes about Three Times as Much Metal in a Given Time

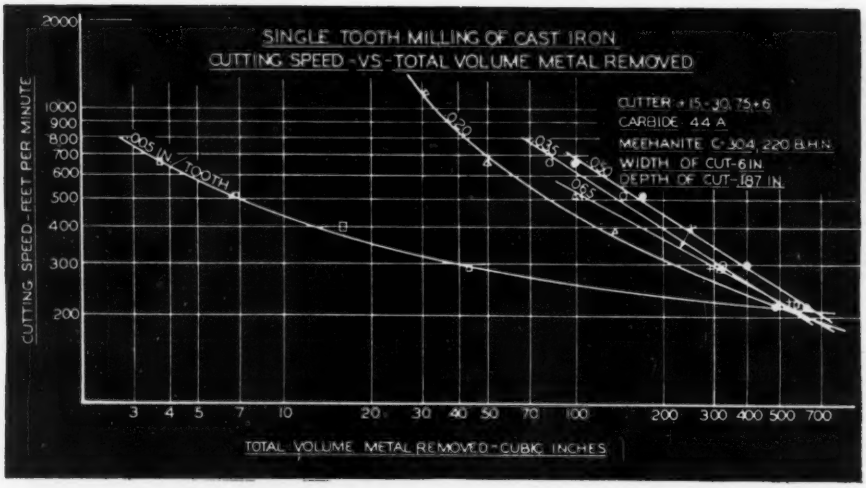


Fig. 8. Results of Milling Tests Made with Varying Feeds per Tooth

poor finish, whereas the Meehanite C-304 castings for the same Profilometer readings appeared less porous and therefore gave the impression of a better finish. The pitted appearance seemed to be related to the graphite flake size, the larger graphite producing the more open finish. The surface finish, on the whole, improved as the speed was increased.

In general, an improvement in finish was obtained as the cut progressed during any one run. The improvement was caused by the wear of the face cutting edge, which increased its length of engagement with the work-piece. A similar improvement in finish was obtained by using a long face cutting edge to start with—that is, about three or four times the feed per tooth. The only disadvantage of the long face cutting edge is that it heats up rapidly, thus sometimes causing a chipping of the cutting edge.

In milling brittle materials such as cast iron, a small portion of the work-piece breaks out at the edge where the cutter leaves the work. This breakout may be unimportant on some parts where this edge of the work-piece will subsequently be machined. On many other jobs, however, the breakout must necessarily be small. In this series of tests, the magnitude of the breakout was found to be a function of the undeformed chip thickness, but was practically independent of the cutting speed within the limits of the test.

The ill effects of an objectionable breakout can sometimes be offset by casting a radius or bevel along the edge where the cutter leaves the work-piece. This practice has been followed on the cylinder bores of automobile engine blocks. Another method which may sometimes be employed to reduce the effect of breakout is to locate the part so that the critical edge is on the side that is engaged first by the cutter.

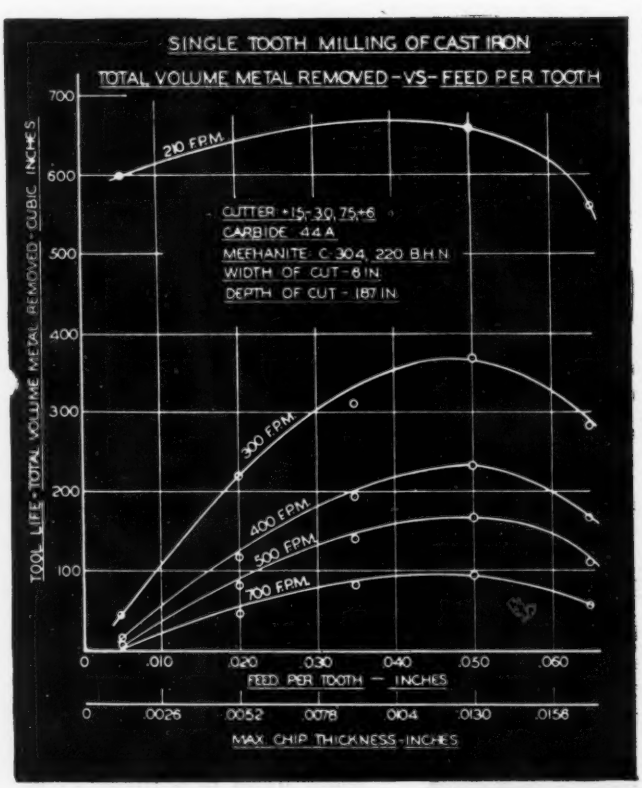


Fig. 9. Volume of Metal Removed in Relation to Feed per Tooth

Power Required for Milling Cast Iron

A series of power tests was made with the cutters shown in Fig. 10. The relation between the efficiency of metal removal (cubic inches per minute per horsepower at the cutter) and the feed rate and feed per tooth for the 12-tooth cutter R8 is indicated in Fig. 11. In this test, a cut 1/8 inch deep and 6 inches wide was made on Meehanite A test blocks at a speed of 300 feet per minute. Feeds up to 100 inches per minute were employed. This corresponds to a maximum feed per tooth of 0.068 inch. The efficiency of metal removal increases with the

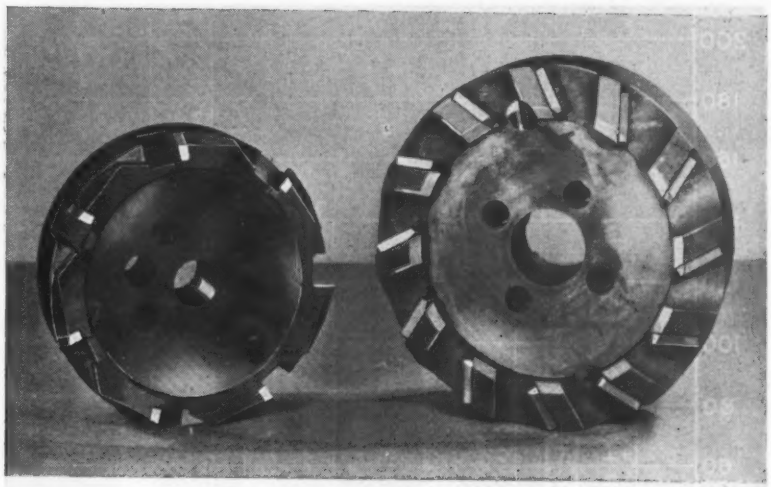


Fig. 10. Two Types of Milling Cutters Used in the Tests

feed rate, as clearly indicated by the curve in Fig. 11.

Cost of Milling

An analysis of the process of milling would be incomplete without the inclusion of cost relationships. The tool life curves obtained in these tests are of prime importance in determining milling costs. So little attention has been paid in the past, even by large users of milling cutters, to the full story of milling costs, and so many misconceptions have arisen as to the savings possible with carbide milling, that it was decided to give this subject attention. Several *erroneous* statements made by production men might be cited:

1. Carbide milling is uneconomical because the time saved in milling is lost in the grinding of cutters.

2. Carbide milling is uneconomical because in many cases the cutter life is no greater than with high-speed steel cutters.

3. It is most economical to run a carbide cutter at the cutting speed which gives the longest tool life.

A cost analysis of milling should include the overhead and labor cost on the milling machine, cutter grinder, and brazing units. Since the overhead on a milling machine is about three times as great as that of a cutter grinder, then, for every hour saved in milling, one could spend two to three extra hours in cutter grinding and still "break even."

The choice of the best cutting speed and feed depends on many considerations. For example,

1. Is the cut roughing or finishing?

2. Is the aim to obtain the maximum number of pieces per hour or to mill at the lowest cost per hour?

3. Is an automatic fixture or an indexing fixture available to reduce the loading and unloading time?

4. Is the work a small or large production job?

From a complete analysis of the factors involved in actual milling costs, the bar graphs, Figs. 12 and 13, were prepared. (The complete analysis was presented in the paper read before the June meeting of the Chicago Section of the American Society of Mechanical Engineers.) Referring first to Fig. 12 pertaining to cutter R6, we note the following results: Assuming the condition of a cutting speed of 280 feet per minute and hand loading as 100 per cent, we see that by increasing the speed to 500 feet per minute, the cost per piece increased to 103 per cent, but the production rose to 128 per cent.

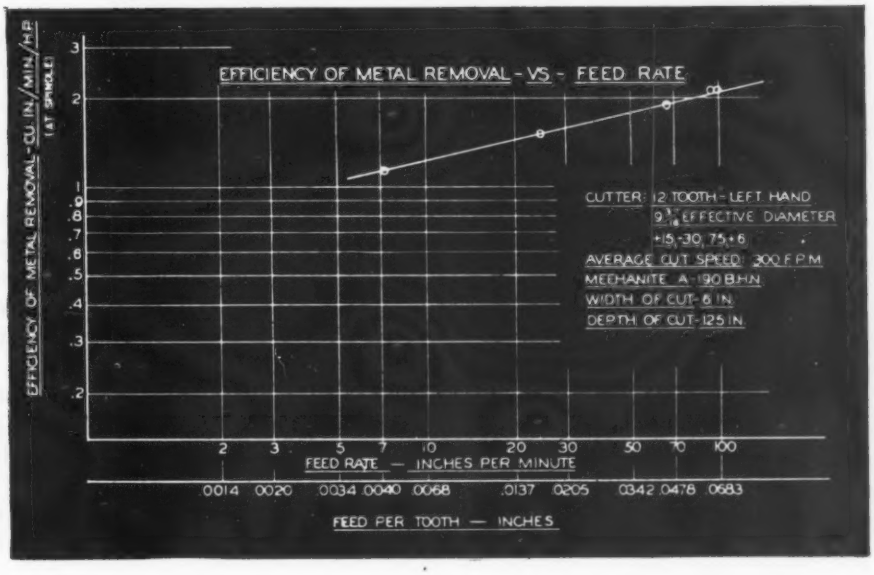

EFFICIENCY OF METAL REMOVAL - VS - FEED RATE
EFFICIENCY OF METAL REMOVAL - CU. IN./MIN./H.P. (AT SPINDLE)
CUTTER: 12 TOOTH - LEFT HAND
9 1/4" EFFECTIVE DIAMETER
+15, -30, 75, +6
AVERAGE CUT SPEED: 300 F.P.M.
MEEHANITE A - 190 B.H.N.
WIDTH OF CUT - 6 IN.
DEPTH OF CUT - 125 IN.
FEED RATE — INCHES PER MINUTE
FEED PER TOOTH — INCHES

Fig. 11. Relation between Efficiency of Metal Removal (Cubic Inches per Minute per Horsepower at the Cutter) and the Feed Rate

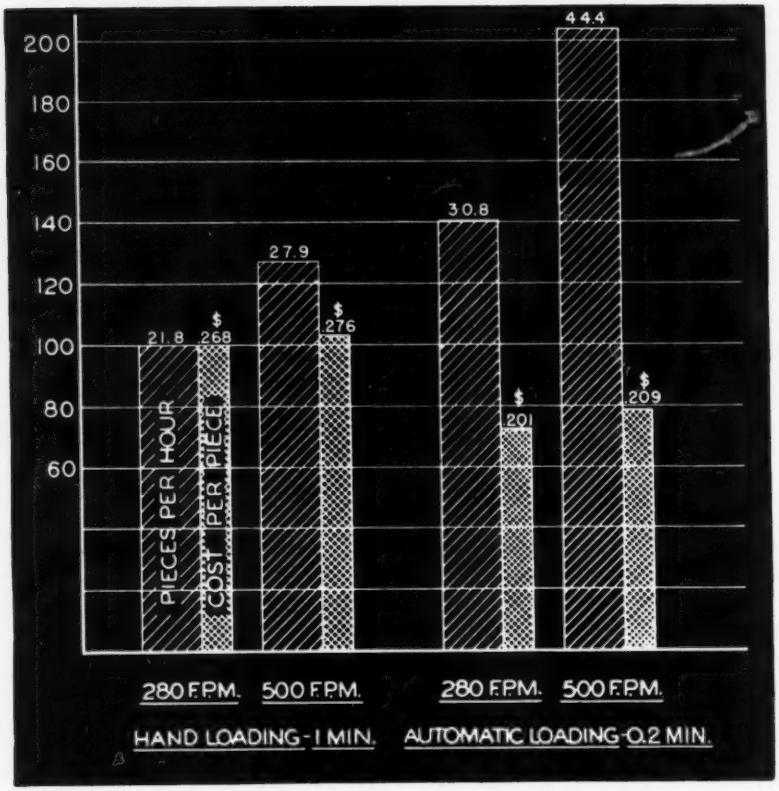


Fig. 12. Cost of Milling with Cutter R6. A Meehanite "A" Block is Milled with a Cut 6- by 20- by 3/16-inch Deep. The Cutter is 10 Inches in Diameter and Has Twelve Teeth

By using automatic loading, but the lower speed, the cost decreased to 75 per cent, while the production rose to 141 per cent. Finally, by combining automatic loading and the higher speed, the cost per piece fell to 78 per cent at the same time that the production increased to 204 per cent.

The bar graph in Fig. 13 refers to cutter R8. The effects of this cutter on cost, it will be noted, are quite different. Again designating the condition of 280 feet per minute cutting speed and hand loading with cutter R6 as 100 per cent, it is seen that cutter R8, for the same speed and type of loading, gave a production of 167 per cent at 62 per cent of the cost. At 500 feet per minute and hand loading, the production was 184 per cent and the cost 73 per cent. With automatic loading and 280 feet per minute, the production rose to 324 per cent, while the cost dropped to 37 per cent. Finally, at 500 feet per minute and automatic loading, the production reached 399 per cent with a cost per piece of 47 per cent of that for the basic condition with cutter R6.

From the foregoing it is, therefore, evident under the conditions of this example that the cutter having a combination of a large negative radial rake of 30 degrees, a corner angle of 75 degrees, and a positive true rake of 6 degrees provides a large increase in production with a considerable decrease in cost per piece.

Conclusions Drawn from Tests

The following conclusions are drawn from the tests undertaken:

1. The results of the tool life tests indicate clearly that the machinability of different cast irons can be compared only on the basis of their characteristic curves that relate tool life to cutting speed and feed per tooth for a particular cutter. The relative tool life will be different if any of these factors is changed.

2. In a cutting speed versus tool life curve, there exists a maximum tool life point toward the lower end of the speed range. This point probably occurs at lower speeds for the harder cast irons.

3. Relatively large differences in machinability exist in ferrous castings which do not differ greatly in Brinell hardness. The evidence thus far accumulated indicates that the machinability is related to metallurgical constituents which do not necessarily determine the average hardness.

4. There exists a maximum tool life point in a tool life versus feed per tooth curve. Curves obtained with different tooth shapes on a given cast iron have the maximum tool life points at approximately the same value of maximum undeformed chip thickness.

5. A cutter which combines a large negative radial rake with a large positive axial rake and a large corner angle (so as to give a positive true rake of about 6 degrees) will remove a considerably greater volume of metal before dulling than the conventional positive rake cutters which are in general use in commercial practice.

6. Tool life comparisons for different conditions vary with the criterion selected for tool life. Three basic criteria exist: (a) Time; (b) number of chips (or tooth impacts); (c) volume of metal removed. The latter criterion is the most useful from the standpoint of prac-

tical application, as it provides a direct indication of the number of parts that can be milled before the tooth has to be resharpened.

7. When milling cast iron with a cutter which combines a large negative radial rake, a large positive axial rake, and a large corner angle, the efficiency of metal removal increases as the feed per tooth is increased. This confirms the results of other investigations with cutters where the rake angles are either both positive or both negative.

8. The cutting speed which gives maximum tool life is not necessarily the optimum cutting speed when all factors which determine milling cost are taken into consideration.

* * *

Gages and Precision Instruments for the Smithsonian Institution

Four early models of gages and precision instruments that have been of the greatest importance in quality control of mass production have been presented to the Smithsonian Institution, Washington, D. C., by Louis Polk, president of the Sheffield Corporation, Dayton, Ohio. Dr. Alexander Wetmore, secretary of the Smithsonian Institution, accepted the gages in a ceremony held in the Board of Regents room of the Institution.

Among the gages presented was the first Sheffield shell Multichek, a multiple electric gage that checks a number of dimensions simultaneously; the first Precisionaire, a flow type air gage for rapid and accurate measuring of internal and external dimensions; an early model of the first comparator using the frictionless reed mechanism and light beam lever arm to be made in the United States; and an early model of the Electrichek, a commercial comparator using electric signal lights.

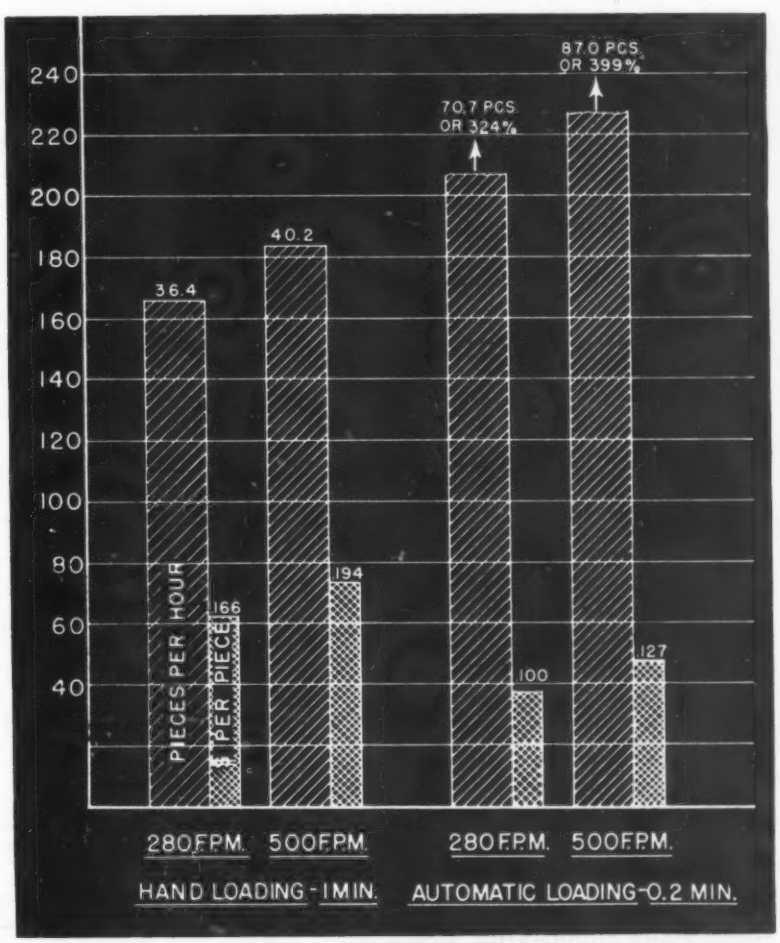


Fig. 13. Cost of Milling with Cutter R8, Indicating Advantage of This Type of Cutter. All Conditions Are the Same as in the Case of the R6 Cutter (Used for Results in Fig. 12), except for the Rake and Corner Angles of the Cutter Teeth

New Method of Salvaging Castings

Castings that were formerly scrapped because of porosity or pin-hole cracks are now being salvaged by the use of Mogul Cast-Seal solution, which is forced into defective castings under pressure. Special equipment has been made available by the Metallizing Co. of America, 1330 W. Congress St., Chicago 7, Ill., for forcing the heated solution into the castings. The Mogul solution, being forced into the pin-holes or cracks, forms a bond that will effectively seal the openings for the life of the casting.

* * *

Plastic Pipe Seals

Plastic pipe seals are now being made regularly for the market by the American Molded Products Co., 1644 N. Honore St., Chicago 22, Ill. These seals also act as protectors for the internal thread of the pipe. They are provided with a countersink for a socket wrench, but are also available in square-head patterns.

Checking Pitch Diameters of

Equations for Calculating Measurement over Pins or Wires when Pitch Diameter is Standard or Basic

IN checking the pitch diameter E of a screw thread by measuring over pins or wires, the measurement M is affected not only by the lead angle and thread angle, but also by the profile or cross-sectional shape of the thread. The profile depends upon the method of cutting or otherwise forming the thread. There are three general cases to be considered.

Three General Classes of Screw Thread Profiles

Case 1—A *screw helicoid* is represented by a screw thread having a straight-line profile in the axial plane. Such a screw thread may be cut in a lathe by using a straight-sided single-point tool, provided the top surface lies in the axial plane.

Case 2—An *involute helicoid* is represented either by a screw thread or a helical gear tooth having an involute profile in a plane perpendicular to the axis (axis of rotation in case of a gear). A rolled screw thread, theoretically at least, is an exact involute helicoid.

Case 3—An *intermediate profile*, which lies somewhere between the screw helicoid (Case 1) and the involute helicoid (Case 2), will be formed on a screw thread either by milling or grinding with a straight-sided wheel set in alignment with the thread groove. The resulting form will approach closely the involute helicoid form. A thread cut by hobbing, as in a gear-hobbing machine with a hob inclined to align the teeth with the thread groove in the usual manner, may be either an exact involute helicoid or a close approximation.

The helicoidal formula of a screw thread is complex, and unless the thread form is a true involute helicoid, all the equations known to the writer for calculating the measurement over pins or wires are either approximations or a series of indeterminate equations which must be solved by successive trials. In order to have a simple equation, it is necessary to make some simplifying assumptions; hence, many different equations may be developed, and most of them will give quite similar results when the simplifying assumptions are reasonable ones.

The writer has derived an exact equation for the position of a wire in the tooth space of an involute helical gear. This form is an involute helicoid. (The equation given in "Manual of Gear Design," Section 3, page 150, is a very close approximation.) This involute helical gear formula also gives theoretically correct results when applied to a screw thread of the involute helicoidal form, and very close approximations for threads having intermediate profiles (Case 3). In the equations that follow,

r_2 = radius to center of measuring wire or roll, inches;

R_b = radius of base cylinder of gear, inches;

R_1 = radius at which tooth thickness is known, inches (generally the pitch radius);

ϕ_1 = pressure angle at R_1 in plane of rotation of gear;

ϕ_2 = pressure angle at r_2 in plane of rotation of gear;

W = radius of measuring wire or roll, inches;

ω_1 = helix angle of gear at R_1;

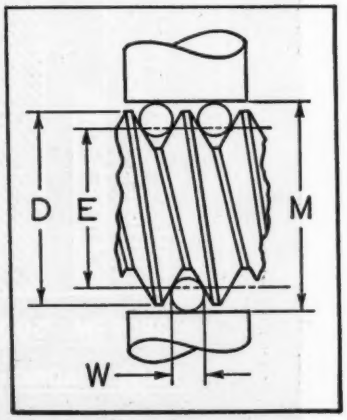
ω_b = helix angle of gear on base cylinder at R_b;

T_n = normal arc thickness of tooth at R_1, inches;

T_1 = arc tooth thickness in plane of rotation at R_1, inches; and

N = number of teeth on gear.

We may have one of two conditions to meet. First, we may know the measurement over the wires of a given gear and need to determine the tooth thickness. Second, we may know the tooth thickness and require the measurement over the wires. For the first type of problem, when the values of W and r_2 are known, the value of the tooth thickness may be determined as follows:



Principal Dimensions Used in Thread Measurements

$$\cos \phi_2 = \frac{R_b}{r_2} \qquad (1)$$

$$\tan \omega_b = \cos \phi_1 \tan \omega_1 \qquad (2)$$

$$T_1 = 2 R_1 \left(\frac{\pi}{N} + \text{inv } \phi_2 - \text{inv } \phi_1 - \frac{W}{R_b \cos \omega_b} \right) \qquad (3)$$

$$T_n = T_1 \cos \omega_1 \qquad (4)$$

Precision Screw Threads

By EARLE BUCKINGHAM
Professor of Mechanical Engineering
Massachusetts Institute of Technology

In the second case, when the values of T_n and W are known, we find the value of r_2 as follows:

$$T_1 = \frac{T_n}{\cos \omega_1} \quad (5)$$

$$\tan \omega_b = \cos \phi_1 \tan \omega_1 \quad (2)$$

$$\text{inv } \phi_2 = \frac{T_1}{2R_1} + \text{inv } \phi_1 + \frac{W}{R_b \cos \omega_b} - \frac{\pi}{N} \quad (6)$$

$$r_2 = \frac{R_b}{\cos \phi_2} \quad (7)$$

Any measurement over the wires should be between two flat, parallel surfaces which hold the wires in position on the gear. These formulas are applicable whether the number of teeth is odd or even.

Example 1—The example that follows illustrates the second case mentioned, in which the radius (r_2) to the center of the wire or roll is required.

$N = 30$; $R_1 = 2.500$; $\phi_1 = 20$ degrees

$T_1 = 0.2618$

$\omega_1 = 23$ degrees; $W = 0.12908$; $R_b = 2.34923$

$\cos \phi_1 = 0.93969$; $\tan \omega_1 = 0.42447$

$\tan \omega_b = 0.93969 \times 0.42447 = 0.39887$

$\omega_b = 21.746$ degrees $\quad \cos \omega_b = 0.92884$

$$\text{inv } \phi_2 = \frac{0.2618}{5.000} + 0.01490 + \frac{0.12908}{2.34923 \times 0.92884} - \frac{3.1416}{30} = 0.02169$$

A table of involute functions shows that 22.560 degrees is the angular equivalent of 0.02169. (For involute functions, see "Manual of Gear Design," Section 1, pages 100 to 129.)

$\cos \phi_2 = 0.92348$

$$r_2 = \frac{2.34923}{0.92348} = 2.54389$$

Note: This is the same example as given in the "Manual of Gear Design" (Section 3, page 150), and the corresponding value there is equal to $r = 2.54393$ inches.

Helical Gear Equation Applied to Screw Thread Measurement

In applying the helical gear equation to a screw thread, use either the axial or normal thread angle (pressure angle) and the lead angle of the helix. In order to keep the solution on a practical basis, one of the thread angles (ϕ_x or ϕ_n) in the following equations is assumed to equal the cutter angle for milled threads. Actually, the profile of a milled thread will have some curvature in both axial and normal sections; hence angles ϕ_x and ϕ_n represent the angular approximations of these slightly curved profiles.

ϕ_x = axial thread or pressure angle (one-half included angle);

ϕ_n = normal thread or pressure angle (one-half included angle);

λ = lead angle at pitch radius or angle between a tangent to pitch helix and plane of rotation;

R_1 = pitch radius of thread, inches;

L = lead of thread, inches;

T_x = axial thread thickness at R_1, inches; and

N = number of "starts" or threads.

All other symbols are the same as before.

$$\omega_1 = 90 \text{ deg.} - \lambda \quad \text{or} \quad \tan \omega_1 = \cot \lambda \quad (8)$$

$$\tan \phi_1 = \frac{\tan \phi_x}{\tan \lambda} = \frac{\tan \phi_n}{\sin \lambda} \quad (9)$$

$$R_b = R_1 \cos \phi_1 \quad (10)$$

$$T_1 = \frac{T_x}{\tan \lambda} \quad (11)$$

These equations give the values needed to solve the screw thread problem as a helical gear problem.

Example 2—$N = 6$; $R_1 = 0.3125$; $\phi_n = 20$ degrees; $L = 0.864$; $T_x = 0.072$; $W = 0.035065$

Whence

$$\tan \lambda = \frac{0.864}{1.9635} = 0.44003$$

$\lambda = 23.751$ degrees $\quad \sin \lambda = 0.40276$

$\omega_1 = 90$ deg. $- 23.751$ deg. $= 66.249$ deg.

$\tan \omega_1 = 2.27257$

$$\tan \phi_1 = \frac{0.36397}{0.40276} = 0.90369$$

$\phi_1 = 42.104$ degrees $\quad \cos \phi_1 = 0.74193$

$\text{inv } \phi_1 = 0.16884$

$R_b = 0.3125 \times 0.74193 = 0.23185$

$$T_1 = \frac{0.072}{0.44003} = 0.16362$$

$\tan \omega_b = 0.74193 \times 2.27257 = 1.68609$

$\omega_b = 59.328$ degrees $\quad \cos \omega_b = 0.51012$

$$\text{inv } \phi_2 = \frac{0.16362}{0.625} + 0.16884 + \frac{0.035065}{0.23185 \times 0.51012} - \frac{3.1416}{6} = 0.20351$$

$\phi_2 = 44.350$ degrees $\quad \cos \phi_2 = 0.71508$

$$r_2 = \frac{0.23185}{0.71508} = 0.32423$$

$M = 2\ (r_2 + 0.035065) = 0.71859 =$ measurement over pins or wires when pitch diameter is basic.

This value checks very closely with the value calculated by means of Tomlinson's equations (G. A. Tomlinson, "Proceedings of the Institution of Mechanical Engineers," London, 1927, page 1031). The Tomlinson equations are complex, indeterminate, and require successive trial solutions. The foregoing translation of the screw thread into an equivalent helical gear is complex enough, but it is a *direct* solution, and the writer believes that it is simpler than the Tomlinson equations.

Since screw thread profiles, as previously pointed out, may range from a screw helicoid to an involute helicoid, and as the precise shape is affected by the method of cutting or forming (or even by the size of the cutter in the case of milled threads), it is evident that an exact and reasonably simple general equation applicable to all classes of profiles cannot be established. However, the involute helicoid formula, as just demonstrated, provides one method of obtaining a close approximation to the theoretically correct measurement over the wires.

Robbing Peter to Pay Paul

Government can put people on a payroll—but Government cannot create wealth. Only production can create wealth. When Paul goes on the Government payroll, it simply means that some of the product that Peter creates in private industry is used to keep Paul alive.

It would seem better sense to get Paul a job along with Peter, so that both of them would be creating the products on which they live, instead of having one support the other. That's the picture that manufacturers see so clearly, because they run the enterprises that create the real wealth of this country.

Industry knows pretty well how to tackle its post-war employment job. Industry knows that in order to maintain employment and payrolls, it has to make better things for more people at lower prices. That's the way to get the volume needed to support the employment required.—*George T. Trundle, Jr., in "Trundle Talks"*

* * *

Twenty years is considered the average service period of an ocean-going vessel in the American Merchant Marine.

Transparent Tenite Tubing is Used for Storage Containers for Drawings or Blueprints. The Cylinders Keep the Drawings Free from Dust, Prevent Them from being Frayed or Torn in Storage, and Provide a Compact Means of Filing. This Tubing is Continuously Extruded in Various Diameters, Cut to the Desired Length, and Sealed on One End with a Tenite Disk. The Other End Has a Wooden Stopper which Bears an Identifying Label

Some Applications of Sub-Zero Treatment to Steel

By STEWART M. DePOY, Metallurgist
Delco Products Division
General Motors Corporation

Specific Examples that Indicate what can be Accomplished by Cold-Treatment of Steel for Tools and Other Purposes

MUCH has been written on the sub-zero treatment of steel. Some writers have claimed Utopian results, such as an increase of 100 per cent or more in the productivity of high-speed steels, while others assert that the process cannot possibly improve a tool that has already been properly heat-treated. It would be unfortunate if this useful process should become an overnight metallurgical fad, to be discarded at its first apparent failure. To emphasize the real value of the process, the writer wishes to point out a few of its uses that may not yet be thoroughly appreciated.

A Recapitulation of Accepted Facts

There is no doubt that the submission of a properly austenitized steel to sub-zero temperatures will bring about a more uniform and complete transformation of the solution structure of that steel than can be obtained by mere quenching and drawing. In some cases, the completeness of this transformation and the resultant hardness is very important. It has been proved by Fletcher that the ultimate transformation of austenite to martensite may take place in a carbon steel without the aid of sub-zero treatment. However, he has also shown that this transformation requires a prolonged period of time. The period may be as much as six months, and in some cases more. In these days of high-speed production, such an aging period would become a serious bottleneck. Consequently, most gage manufacturers have adopted the sub-zero treatment for their products. With this treatment, the required transformation is a matter of hours, and the gages can be shipped with the assurance that they will not change in size while in use.

Application to Machine Tool Parts

By the same token, this process can be very useful to the builder of precision machine tools. It may be safely stated that 30 per cent of the carburized gears in modern machine tools have a detrimental amount of retained austenite in the carburized case, which might cause premature failure. This statement should not be understood to mean that these gears do not fulfill their purpose; but it does mean that these gears would have a longer life if the transformation of the austenite had been more complete. This transformation will easily take place if the carburized gears are subjected to a temperature of minus 120 degrees F., or lower, for a few hours. Treatments such as this have raised the Rockwell hardness of gears from 55 C to as high as 65 C without loss of impact resistance qualities. In fact, it has been shown in some cases that the impact and fatigue resistance of a carburized case is raised by cold-treatment.

The treatment is also useful for stabilizing or aging precision bearings and other vital parts of precision machine tools. These bearings may be made from S A E 52100 or alloy carburizing steels. Time aging of the 52100 steels after hardening has been found to bring about changes as great as 0.0025 inch in medium-sized sections. One can readily see the trouble that may be caused by a change of 0.0025 inch in the measuring mechanism of a large boring mill. This does not mean that the manufacturers of precision machine tools place on the market equipment with important parts unstabilized. Far from it. They go to great care and expense in processing and inspection to produce dependable machines. However, the use of cold-treatment on many parts would greatly simplify the processing during heat-treatment and subsequent finishing.

Application to High-Alloy Die Steels

Low-temperature refrigeration has a marked effect on high-alloy die steels of the air-hardening type. These materials, especially the 5 per cent chromium type, are very likely to exhibit retained austenite. In order to transform this retained austenite by ordinary methods, it is necessary to multi-temper the steel at from 925 to 975 degrees F. This treatment will produce a sufficient transformation, but the resultant hardness will be from 57 to 61 Rockwell C. For most applications this would be satisfactory, but it would not be the best obtainable hardness. Further, very small differences in austenitizing temperatures and cooling rates will cause

a considerable difference in the size change of these materials.

The application of sub-zero treatment at minus 120 degrees F. will remedy these troubles. The transformation may be completed without using high tempering temperatures, thus producing a harder and more abrasive material. The size change will always be uniform, because the amount of transformation will be uniform at minus 120 degrees F. Higher austenitizing temperatures which, in turn, give more carbide solution, may be used if the material is subjected to refrigeration after a quench and draw. The result will be high hardness and abrasive resistance, and the size change will be about the same, regardless of the austenitizing temperature.

Without the use of refrigeration, high austenitizing temperatures are detrimental, since they create a very stable austenite. In some cases, this stable austenite has resulted in a nonmagnetic structure with a hardness of only from 35 to 45 Rockwell C. A cold-treatment cycle will quickly remedy this difficulty.

It must be remembered that refrigeration, if effective, will always cause an increase in size. If refrigeration is used during the heat-treating cycle, this increase in volume will be uniform. However, if the cold-treatment is used on materials that are finished and have been lying on the shelf for any length of time, the volume increase will be affected by the original amount of retained austenite and the amount of stabilization that has taken place due to room temperature aging. The effect of refrigeration on the productive capacity of "shelf" tools has been argued pro and con in metallurgical and tool engineering circles for some time. However, refrigeration will generally cause an increase in the size of these tools. This fact, in one instance, made refrigeration a very handy salvage process; one manufacturer salvaged $50,000 worth of taps that had been finished from 0.0005 to 0.0015 inch under size.

Some Recent Observations on Cold-Treatment

Some recent experiments have shown that certain tempering temperatures may cause refrigeration treatment to have a detrimental effect. In Fig. 1 are plotted the tempering temperatures versus Rockwell hardness for M-2 high-speed steel. Drawing at 600 degrees F. will stabilize the resultant structure so that refrigeration at minus 120 degrees F. is ineffective. However, this fact may be of use on some tools requiring toughness and ductility. Fig. 2 shows the result of the same tests made on GM-100-M die steel. Refrigeration shifts the peak of the secondary hardness curve 50 degrees lower for M-2 steel. This is not true of 100-M steel. These curves show that if maximum hardness is required, tempering at from 500 to 900 degrees F. should be avoided.

In order to identify the M-2 and 100-M steels referred to in the preceding paragraph, the composition of these steels should be given. The typical analysis of the M-2 steel is as follows: Carbon, 0.85; manganese, 0.22; phosphorus, 0.029; sulphur, 0.008; silicon, 0.32; chromium, 4.19; tungsten, 6.53; molybdenum, 5.16; and vanadium, 1.98 per cent. A typical analysis of 100-M steel is as follows: Carbon, 1.02; manganese, 0.61; phosphorus, 0.012; sul-

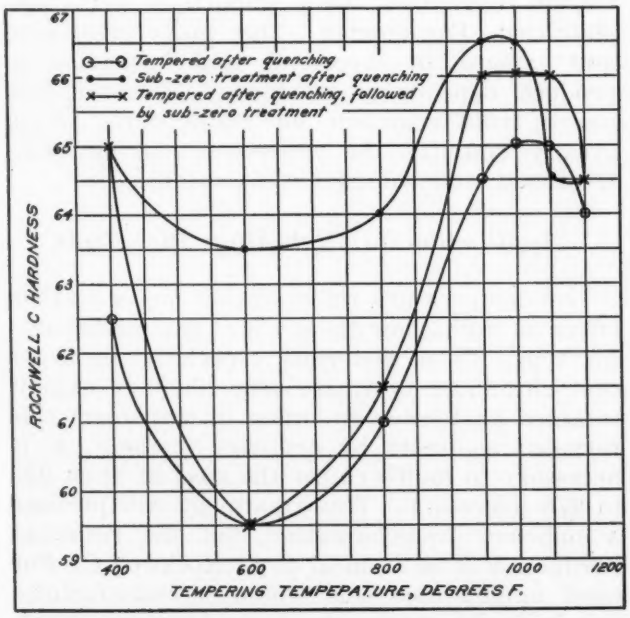


Fig. 1. Effect of Tempering on Sub-zero Treatment of M-2 Steel Austenitized at 2225 Degrees F.

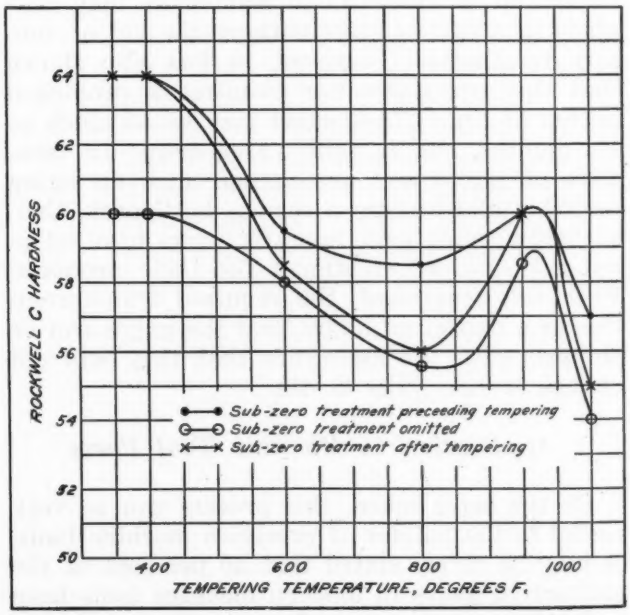


Fig. 2. Effect of Tempering on Sub-zero Treatment of GM-100-M Steel Austenitized at 1800 Degrees F.

phur, 0.013; silicon, 0.30; chromium, 5.23; molybdenum, 1.09; and vanadium, 0.29 per cent.

To sum up, it is not the purpose of this article to convince the reader that cold-treatment is a necessity for making good high-speed steel cutting tools. However, it may be safely stated that this treatment will not be detrimental to cutting tools; and in many cases it may improve them. Most important, the process may be used for many parts other than cutting tools and the results obtained will be more uniform than otherwise possible.

Metallurgists and tool engineers differ in their opinions on the merits of sub-zero treatment. However, we must bear in mind that the performance of the tool or other product is the important factor. Microstructure and physical properties are only important as indications and as means for obtaining the desired end.

Protecting Rights of Inventors from Infringements By U. S. Government

By B. E. SHLESINGER, Patent Attorney, Rochester, N. Y.

Congressman Wadsworth has recently introduced in the House of Representatives a bill, H.R. 1583, to improve procedure in the Court of Claims and the U. S. District Courts when suits are brought against the Federal Government and its contractors for patent infringements. This bill is a revision of H.R. 6056, on which some hearings were held by the House Judiciary Committee in December, 1941. These hearings were interrupted by Pearl Harbor and have never been resumed.

That there is a crying need for reform of Court of Claims procedure in patent cases is well known to anyone even remotely acquainted with the decisions of this Court in the last quarter of a century. The decision of the Court in Pollen et al. vs. U. S. (59 U.S.P.Q. 228), decided in 1943, illustrates quite clearly how justice may miscarry in a case where an inventor brings suit against the U. S. Government.

In this case, the inventor was suing for infringement of his invention by the Navy. The Navy refused to comply with an order of the Court to allow inspection of the devices which it had made, and the Court, being helpless to enforce its order in the face of the Navy's refusal to obey the Court order, held it could make no findings as to infringement or validity, and dismissed the case. Then, to add insult to injury, it assessed the cost of printing the record against the plaintiff.

During the present war, the Government and its contractors have used many patented inventions. After the war, there will undoubtedly be a great number of suits to recover for the use of these inventions. If the history of the last quarter century is any criterion, the patent owners are doomed to bitter disappointment, because present procedure provides no adequate remedy.

Patents are not dealt with on the same basis as other property. If the Government wants a man's farm to build a munitions factory on it, the Government pays for it, and usually a better price than the owner could get for it in the open market; but if the Government wants a man's patent, it takes it, and it can tell the man to whistle for his pay. In that event, the man may find himself in the hollow chambers of the Court of Claims, with his whistle producing only a mocking echo.

Under present procedure, the Court of Claims cannot compel the Army or Navy to disclose to the Court itself, even in chambers, the extent of the use of an invention. If the Army or Navy is unwilling to give the Court information, the Court cannot force either department to do so. The result is that an inventor whose invention has been used by the Government is helpless to obtain any judicial determination of his right to recover for the use of that invention. Congressman Wadsworth's bill endeavors to right this situation.

The new bill, H.R. 1583, is not perfect, but it is a beginning. Now is the time to begin considering revamping the Court of Claims procedure. We should not wait until after the war to begin consideration of this matter. That may be too late. Surely the Government and the people of the United States should be willing to aid the great army of inventors, who have had no little share in the winning of this war and in the preserving of our American way of life, to obtain some measure of justice.

* * *

Strife between groups within a nation may be just as wasteful and destructive as wars carried on between nations.

Electronic Control Makes Bench Welder a Precise Production Tool

By L. J. GOTTSCHALK, Jr., Application Engineer
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TWO types of electronic controls have made possible the precise control of the amount and duration of current flow needed to give bench welders the accuracy and consistency required for a wide range of difficult welding jobs. With these controls, the amount of current can be varied from under a hundred to several hundred amperes, and the length of time it flows from one-half cycle to thirty cycles or more. Bench welders equipped with one or the other of these controls are now joining small pieces of silver, copper, and molybdenum, as well as various other difficult-to-weld alloys and steels on a production basis.

In the welding of small pieces of these metals, overheating may cause undesirable internal changes in the metals, while underheating will result in an inferior weld. Hence, there is need for exact control of the welding current. Furthermore, this heat must be confined to the area about the weld, and in the case of good heat conducting metals, such as copper or aluminum, this necessitates the use of a high current for an extremely short welding period. On the other hand, a high current of short duration is undesirable for certain other applications, because it might cause brittleness of the weld or might even result in explosive action at the instant the weld occurs. In such cases, a smaller current for a longer time is suitable.

These factors create the need for two general types of welder control: (1) The half-cycle timer, which has made it possible to obtain a heavy welding current of short duration; and (2) the full-cycle timer, which is used for feeding a small amount of current to the welder for a longer period of time. Each of these controls has its particular applications according to the nature of the welding problems encountered.

Typical of bench assembly problems is that of fitting together the three metal pieces *A*, *B*, and *C* shown in Fig. 1 to form part of a thermal

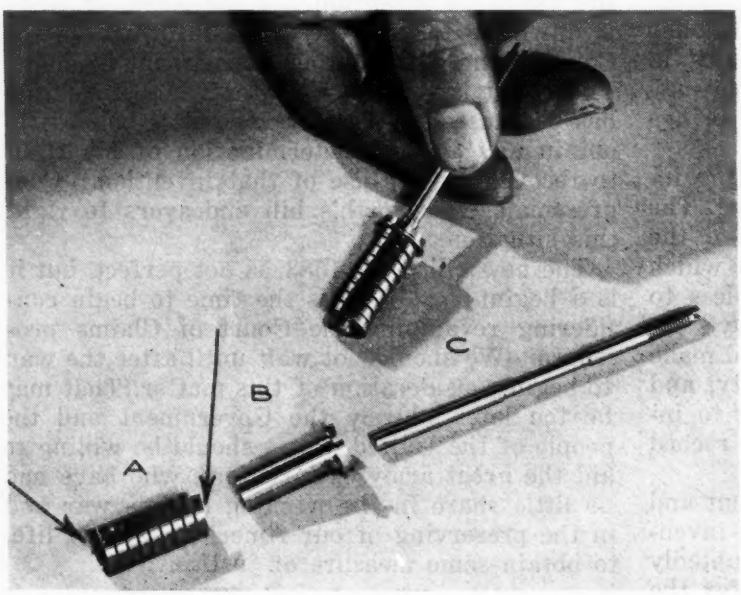

Fig. 1. The Three Metal Pieces A, B, and C are to be Joined to Form the Assembly Seen Above. Arrow at Left Points to Spot at which Coil A is to be Welded to End of Rod C, while Other Arrow Shows Spot to be Welded to Cylinder B

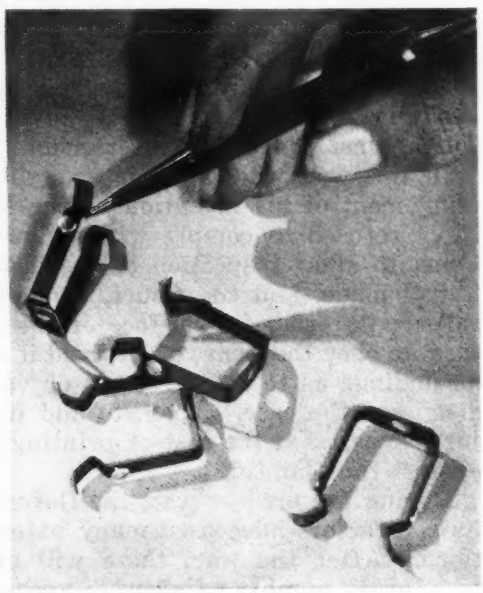

Fig. 2. Joining a Silver Contact Button to a Copper Arm by Resistance Welding on a Bench Welder Equipped with a One-half Cycle Timer Control

Fig. 3. Bimetal Thermostatic Coils are being Welded to Other Metal Pieces to Form Part of a Thermal Protective Device. Overheating during the Weld would Damage the Bimetal; Therefore, the Welding Action Must be Effected before the Coil can Become Hot. Precise Electronic Control of the Bench Welder Makes This Possible

protective device. Cylinder *B* is inserted in bimetal coil *A* and then welded to the right end of the coil. Rod *C* is inserted in cylinder *B* until it extends far enough to weld it to the left end of coil *A*. The two arrows point to the spots on coil *A* at which the welds are to be made. The finished assemblage is shown above the parts. The production set-up for this control part is shown in Fig. 3.

Every known means of metal joining was tried for this particular production job before resistance welding was finally adopted. Even then resistance welding would not have been satisfactory had not electronics made possible the precise control of the amount and duration of current flow, for the bimetal coil creates a special problem.

A small flow of current for a long period of time produces slow heating that raises the temperature of the entire coil excessively, thereby destroying its desired physical properties. What is needed is a surge of current of sufficient magnitude to form the weld, yet of short enough duration to prevent overheating throughout the coil. Thus a control is required that is capable of supplying consistently the exact amount of current for a predetermined period of time for each successive weld. The time consumed from the start of the weld to the finish is around 1/120 second.

Another interesting problem calling for precisely controlled bench welding arose in connection with the testing of "Kovar," an alloy with a coefficient of expansion virtually the same as that of certain commonly used types of glass. This property permits "Kovar" to be passed through glass seals without danger of the glass cracking and leaking as a result of differences in expansion and contraction due to wide temperature changes. The glass and "Kovar" must contract and expand at precisely the same rate; hence absolute consistency of the alloy is a requisite.

One of the tests to insure this consistency necessitated the attachment of a very fine thermo-couple wire to a rod made from a batch of this alloy. Expansion tests could then be run on the sample, and the attached thermo-couple would give an exact indication of the rod temperature. However, considerable difficulty was encountered in joining the thermo-couple wire to the rod.

Method after method was tried. Brazing or soldering would not stand up under high temperatures; wrapping the wire around the rod would not give the needed intimacy of contact; and arc or gas welding would not do, for the same basic reason that resistance welding without precise electronic control proved unsatisfactory, because the relatively slow heating raised the temperature of the rod to the point where it lost certain of its physical properties due to internal changes in structure. Resistance welding with electronic control was found to be satisfactory, since a thermo-couple wire could be welded to the sample rod by passing a high surge of current through it for an extremely short period of time without affecting the physical properties of "Kovar." The bench welder and one-half cycle timer used in this production job are shown in Fig. 4.

The attachment of silver contact buttons to copper contact arms, as shown in Fig. 2, presented a somewhat difficult problem, for the reason that both metals are good conductors of electricity and heat, and are not therefore easily adapted to resistance welding. Laboratory tests proved that a high surge of welding current for a short period of time produced a satisfactory joint. The accuracy of current control demanded by this application closed the field to all but electronic control. As a result, this job is being

done on a mass production basis by the bench welder equipped with a one-half cycle timer.

Far different in control requirements is the attaching of a copper lead wire to the zinc casing of a dry-cell battery. A high surge of current causes the zinc in the dry-cell casing to vaporize with explosive action. Tests indicated that this job required a relatively low current for a longer period of time; but precise control is still necessary. As slight variations in the amount of current resulted in a great increase in the number of rejected parts, it was evident once again that electronic control was needed to do the job.

Another problem that required a control capable of furnishing a small welding current for a longer period arose when two pieces of 0.02-inch thick, 0.50 per cent carbon steel were to be attached to each side of a 0.005-inch thick blade of 1.20 per cent carbon steel. The completed assemblage was first made with the half-cycle timer furnishing one short heavy surge of current. When the specimen welded in this manner was tested, it was found that the brittle welds in the blade pulled out, leaving holes, which showed that the welds were unsatisfactory.

Another assembly of the same materials was then welded with a lower current for a longer time, followed by a passage of a second smaller current for a short time. This second passage of current acted as a normalizing or annealing medium to prevent the weld from becoming brittle. When this specimen was tested, it was found that the welds were much superior. Upon application of stress, instead of holes being torn in the blade, a large section of the milder steel pieces was ripped out, indicating that the welds were much stronger.

These examples illustrate why precise control is necessary for many bench welding jobs and why two entirely different types of electronic controls are needed to perform these jobs properly. In one instance, the control must furnish the welder transformer primary a current of several hundred amperes for an accurately timed period of less than 1/100 second, while in the other instance, the control is called upon to deliver a much smaller amount of current for as long as a half second.

Economics prohibit the building of these extreme ranges of both time and current into a single control. As a result, two general classes of bench welder controls are commonly used. The so-called half-cycle weld timer is typical of the kind that supplies the welder with a single short impulse of current. The other timer is designed to accurately measure alternating currents smaller in magnitude for periods from 1/2 to 30 cycles based on 60-cycle power supply.

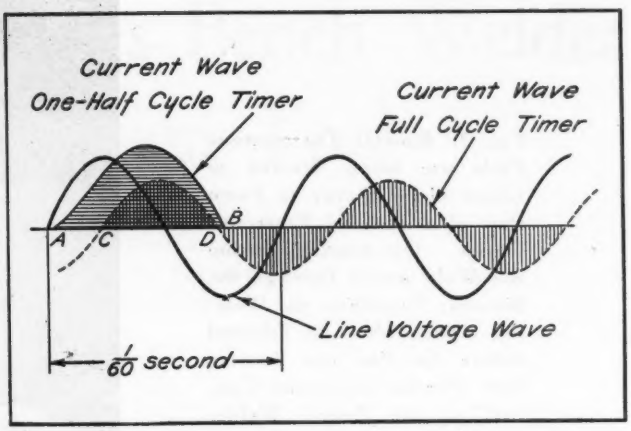

Fig. 5. Comparison of Current Waves for Half-cycle and Full-cycle Timers, Showing Greatly Increased Current Flow Obtainable with Half-cycle Conduction

Fig. 4. A Delicate Welding Operation in which Fine Thermo-couple Wires are Joined to the "Kovar" Test Rod Seen between the Welding Electrodes. This Must be Done without Overheating the Rod; otherwise Its Metallurgical and Physical Properties will be Adversely Affected. The Electronic Timer, Seen in the Background, Measures out a Surge of Current Lasting but a Hundredth of a Second to Form the Weld

The current control used to feed lower currents for longer periods into bench-welder transformer primaries utilizes a pair of mercury-vapor grid-controlled thyratrons as power switches. The term "power switches" is used because the function of this pair of thyratrons is to make and break the circuit to the welder at precisely controlled intervals of time. A normal welding time range for such a control would be from 1/2 cycle to 30 cycles in one-cycle steps, based on operation from a 60-cycle power supply. Thus, each cycle of welding current lasts one-sixtieth second.

Accurate time control is accomplished through the use of auxiliary electronic control circuits which close the "power switches" at the proper instant by means of grid control. Each tube conducts alternate half-cycles of current to the welding transformer until the preset number of cycles has passed. The electronic control then automatically removes the firing potential from the power tubes, causing them to extinguish themselves. This whole process takes place without undesirable arcing or transients which occur with mechanical line contactors, and there is no contactor wear or noise.

The half-cycle timer includes one small air- or water-cooled ignitron to conduct the single surge of welding current into the transformer primary. Since the ignitron conducts in but one direction, it gives but one unidirectional surge of welding current each time it is fired. The magnitude of this surge depends upon the exact instant of firing, since by firing (commencing conduction) earlier or later with respect to the line-voltage wave half-cycle, a larger or smaller amount of current is conducted before the line polarity reverses and extinguishes the ignitron. The electronic timer for the bench welder in Fig. 4 employs but a single tube to control the firing of the ignitron and the duration of current flow. By an ingenious circuit, this tube charges a capacitor and later passes the current which has been stored in it to fire the ignitron at the exact preset instant.

One advantage of employing but one-half cycle of welding current results from the greatly increased heat or current range possible. Fig. 5 illustrates how the single ignitron tube can begin conducting at some point *A* and continue to some point *B*, resulting in a current proportionate to the entire shaded area between the curve *AB* and the axis, and heat proportionate to the square of this current.

With full-cycle conduction, however, current cannot begin to flow before some point *C* if accurate control is desired. Conduction will then end at some point *D* in time for the next half cycle of welding current to begin. The current in this instance is proportionate to the area between *CD* and the axis. Thus double the maximum amount of current can be passed in a single one-half cycle with half-cycle control, compared with what can be passed in one-half cycle with full-cycle conduction. Hence a maximum of four times as much heat is produced. Thus, much more heat can be generated in the same period of time and the heat can be more precisely controlled by the use of a one-half cycle timer, making one-half cycle conduction more desirable for resistance welding applications where high currents of short duration must be accurately measured out.

Bench welding with precise current control, such as has been discussed, is being used more extensively in industry because it fills a definite need. When such exact controls have been tried, they have proved their worth and in frequent cases, have opened the way for assembly methods that have aided materially in our war effort. Hence, reconversion will undoubtedly see greatly increased use of electronic controls for bench welding in many fields.

* * *

Magnetic Inspection Employed by Ford

Magnetic inspection of all bar stock used on Ford-built aircraft engines virtually has eliminated engine failures resulting from defective studs, small gears, bushings, and many other small parts. All bar stock rolled in the Ford Motor Co.'s steel mills for use in Pratt & Whitney 2000-H.P. aircraft engines is inspected on one of two magnetic analyzers at the Rouge plant.

The bar stock, ranging from 1/4 inch to 5 inches in diameter, is passed through a magnetic field, the bar serving as the core of the magnet. Primary and secondary coils make constant comparisons of the metal as it passes through the field, and any deviations are recorded instantly on micro-ammeter dials located on the instrument panel. A special etching device marks the stock where imperfections are indicated by the inspection device. The machine can be adapted to analyze any steel or heat-treatment by "tuning" to the proper frequency.

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Anti-Fog Preparation for Industrial Goggle Lenses

An anti-fog preparation for keeping goggle lenses, face shields, and welding plates clear has been placed on the market by the American Optical Co., Southbridge, Mass. The new anti-fog material, known as "AO," deposits a thin film on the glass which prevents fogging, steaming, and frosting of all types of glass surfaces. It also removes grease and dirt from the glass and allows perfect visibility.

Molding Presses for the Plastics Industries

By F. CHARTRAND, Plastics Divisions
General Electric Co., Pittsfield, Mass.

A Review of the Principal Types, Capacities, and General Design Features of Presses for Molding Plastic Materials

As an ever increasing number of molding plastics are developed to meet the requirements of industry, it becomes increasingly important to the molder to have equipment in his plant capable of producing a wide variety of molded parts. The majority of applications of molding materials are of the thermosetting type; such materials are molded in either the compression or the transfer type of press. As the molding press is relatively the most important piece of equipment in a plastics plant, considerable attention should be given to its selection and design. Moreover, since the particular plastics pieces to be molded determine the press capacity, the type of press selected should have the greatest possible flexibility.

Molding presses generally range in size from 10 to 1500 tons. Presses of larger capacity are built for special applications. Tonnage alone, however, does not fully indicate the size of a molding press. The size, or rather the capacity, of a molding press is a combination of four functions: (1) Tonnage, (2) platen area, (3) daylight, and (4) stroke.

The *tonnage* is the number of tons (of 2000 pounds) pressure that can be exerted on the mold halves between the top and bottom platens. The *platen area* is the size of the top and bottom platens, usually specified as the distance from front to back and from left to right. The distance between the top and bottom platens when the press is fully open is known as the *daylight*. One of the features of a flexible molding press is that it is provided with means for adjusting this distance. Usually the mold heights vary considerably, and the opening required for a particular mold can be obtained by such adjustment. The *stroke* of a press is the maximum distance that the bottom platen moves upward (in the case of an up-moving ram press).

Dimensions of Presses for Molding Plastics

Tonnage	Stroke, Inches	Platen Size, Inches	Daylight, Inches
10	10	12 by 18	12–24
20	10	14 by 22	12–24
30	10	14 by 24	14–24
50	12	20 by 30	14–30
75	12	20 by 30	14–30
100	16	24 by 36	18–36
150	16	24 by 36	24–42
300	24	30 by 42	36–72
500	30	30 by 42	42–72
750	36	42 by 60	42–72
1000	48	54 by 72	42–84
1500	60	60 by 84	42–84

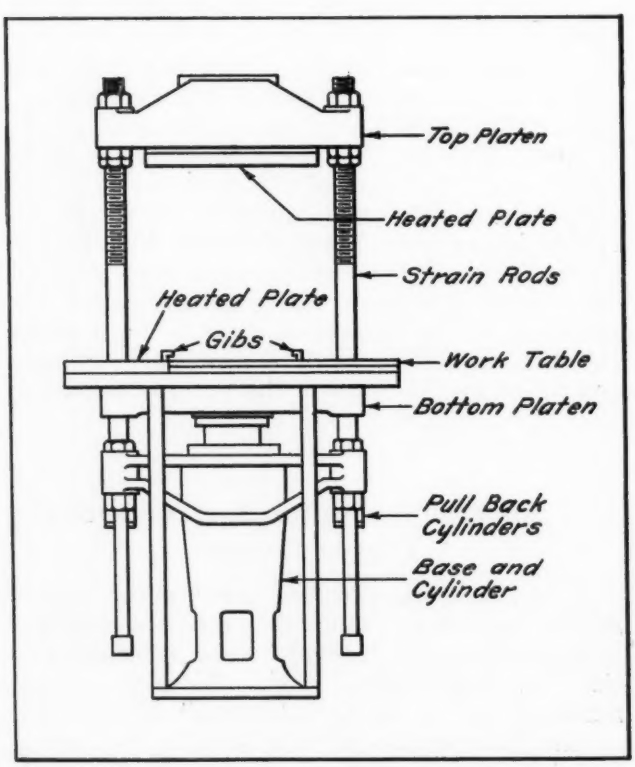


Fig. 1. Features of a Hand-mold Compression Molding Press

A well balanced press should have enough platen area and daylight to accommodate the maximum size mold for which it has been acquired. The stroke and daylight should be sufficient to permit the mold to be easily loaded and the finished parts ejected. Ample tonnage to close the mold is obviously a prime requirement. The accompanying table gives the proportions of various presses used for molding plastics.

There are two principal types of molding presses, classified according to their use—the compression press and the transfer press. In

the compression press, the plastic material is first placed in the mold; then, with the application of heat and pressure for a predetermined length of time, the material is formed into the shape of the mold. Compression presses are subdivided into hand-molding and semi-automatic types.

The transfer press differs from the compression press in that the mold is first closed, and the heated plastic material is then injected into the mold under pressure by means of an auxiliary hydraulic cylinder.

Compression Press Molding

In the hand-mold compression press, shown diagrammatically in Fig. 1, all operations are performed manually. The plastic material is loaded into the bottom half of the mold and the top half is placed over it to form a unit. The mold is then inserted into the gibs of the press and moved into position. The gibs, or guides, serve as a means of locating the mold in the center of the press platen. When the mold has been properly located, the press is closed. The source of heat for the mold is obtained through steam or electrically heated plates secured to the top platen and bottom, or moving, platen of the press. After the material has been cured, the press is opened, the mold is taken out of the press, the two halves are separated manually, and the finished part is removed.

For the operation of a press of this type, a suitable work-table is required in the front of the press, level with the moving platen when the press is open. Incorporated in this work-table is a steam plate on which the mold halves are placed. The purpose of this is to maintain to some degree the heat in the mold, which would otherwise be lost when the mold is out of the press.

The hand-mold compression press is usually of comparatively small capacity, because the operator would be unable to handle manually the large molds used in larger presses. The principal reason for using the hand-mold press is the low mold cost. It is, however, suitable for use only where a few parts are to be molded for laboratory and experimental use. In such cases, this press is very economical.

The semi-automatic compression press, shown diagrammatically in Fig. 2, differs from the hand-mold type in that all the functions of molding are performed by the press as determined by the operator. The mold halves are fastened to the top platen and the moving platen. The mold is channeled or drilled for heating by means of steam or electricity. The loading of the mold and the opening and closing of the press are performed manually, but the finished parts are ejected from the mold by means of a double-acting air cylinder. This type of press is widely used for thermosetting plastic materials, and may be of practically any capacity.

Transfer Molding Presses

Transfer molding presses, shown diagrammatically in Fig. 3, may be of the same general design as the semi-automatic compression presses, but in some features their operation differs from that of the latter. The mold halves are fastened to the moving platen and the top sub-platen. Incorporated in the sub-platen is a pot in which the molding material is loaded. A variation of this design is used, in which a space is provided in the top half of the transfer mold for loading the molding material. However, in this type of press, the injection ram reduces the clamping pressure of the press. Mounted above the top platen is the injection cylinder which is used as a means of transferring the plastic material into the mold or into the cavities. Transfer molding is suitable for the molding of high-impact materials, and for complicated parts where inserts and small-diameter pins must be used in the mold.

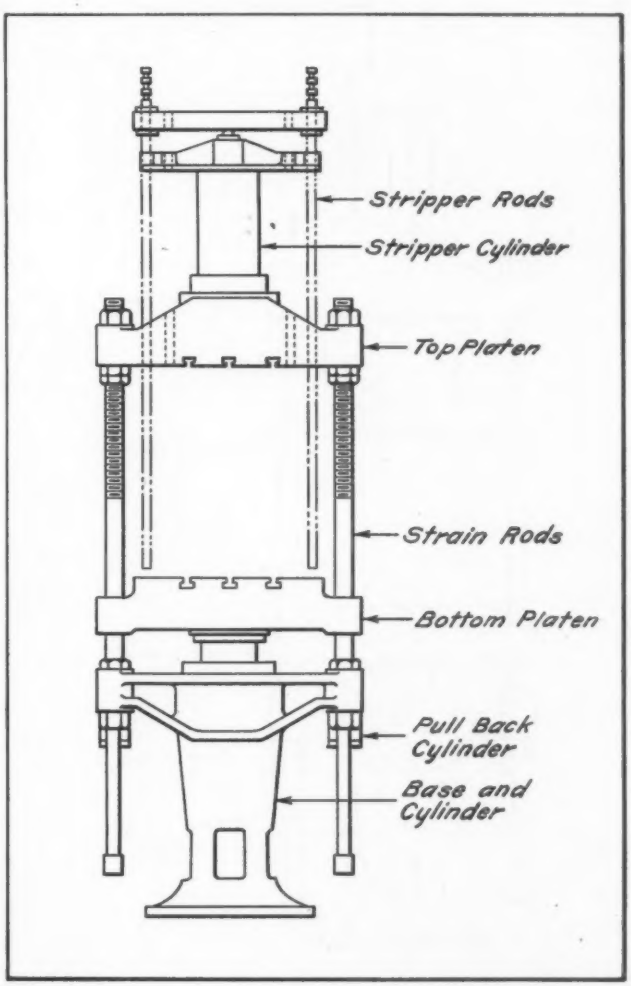


Fig. 2. Outline of Design of a Semi-automatic Compression Press

Design Features of Molding Presses

Whether molding presses are to be used for hand, semi-automatic, or transfer type molding, there are certain design features that are common to all of them. As to the source of power used, there are two general types of presses—mechanical and hydraulic. The former is operated by toggle linkage.

The mechanical type press has a fixed stroke; and because of the inherent disadvantage of a toggle mechanism, the rated capacity is only reached when the mold is finally closed. Moreover, the rated capacity or end pressure is indefinite, and cannot be readily determined.

The hydraulic press is more flexible because of the following reasons:

1. The final pressure on the molds can be predetermined and controlled.
2. The length of stroke is adjustable.

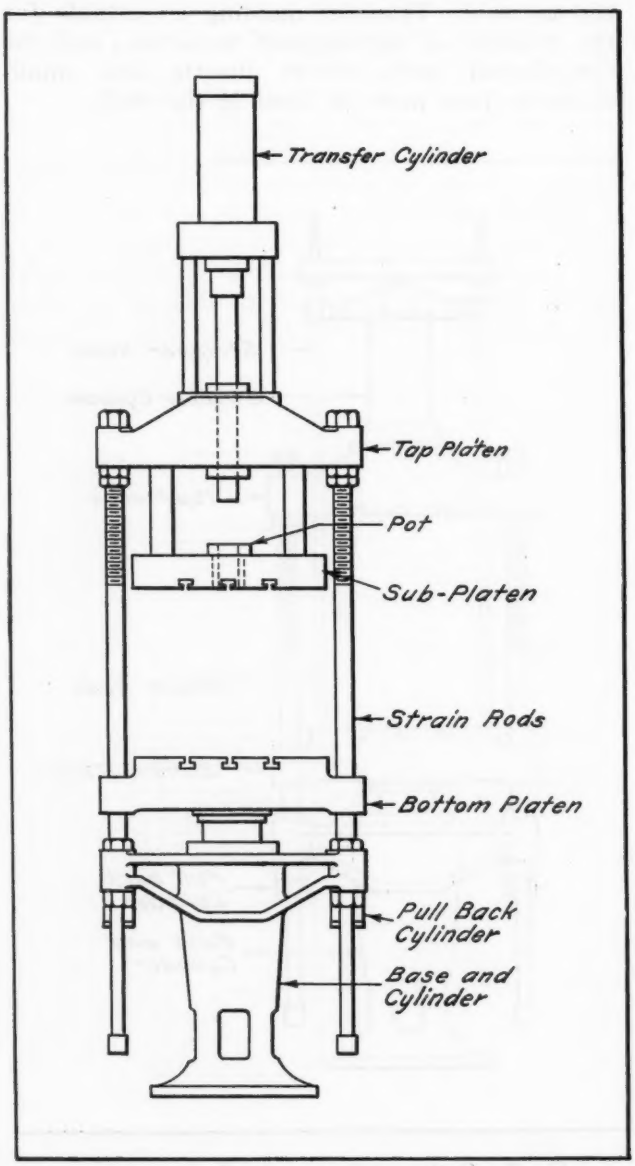


Fig. 3. Outline of Design of a Transfer Molding Press

3. The rate of closing can be controlled to approximate the flow of the material being molded.
4. A predetermined pressure is available throughout the closing cycle.

A molding press can have either an up-moving platen or a down-moving platen. However, the up-moving type lends itself to a more compact design, and the mold-setting costs are less in cases when the daylight must be adjusted. Stripper cylinders can be mounted more easily on the semi-automatic type of press. In the down-moving type of press, the hydraulic connections must be changed whenever the daylight is adjusted, and there is always the possibility that the hydraulic medium may drip down on the molds.

The hydraulic cylinder and base are cast integral. The cylinder and top platen can be tied together with either side plates or with round strain rods. The latter can be threaded or grooved on the ends near the top platen for adjustment of that platen. Mold connections can be made more easily and better light on the molds is obtained with the open strain-rod construction. Daylight adjustment is not feasible with the side-plate construction, because the main reason for using this method is to provide a better means of guiding the moving platen on the sides by the use of machined ways. However, this extreme accuracy is not essential, because the guide pins on the molds are adequate to assure alignment.

Pull-back cylinders are required on molding presses, regardless of their type of construction. Their purpose is to break the mold and return the moving platen to its open position. They are usually rated at 5 or 10 per cent of the total tonnage capacity of the press. Hydraulic type pull-back cylinders are preferred; their operating cost is nil, because they are "floated" on the line. However, if the occasion demands it, additional capacity of the press can be obtained by providing a three-way valve in the pull-back line to release the pressure.

Materials Used for Press Parts

In the modern press, steel castings are used for the integral cylinder and base, the moving platen, and the top platen. The strain rods should be made from hot-rolled steel and smoothly ground. The threads on the strain rods should be machine cut and not die cut. Bronze is preferable for the gland and throat bushings in the cylinder and for the guide bushings on the moving platen. Outside-packed rams are most easily maintained, and a good self-sealing type of packing should be used.

When water is used as the hydraulic medium, precautions should be taken to prevent corrosion of the ram. Rapid corrosion of the steel rams results in excessive packing failure. Ex-

cellent results have been obtained with the use of stainless-steel sprayed rams. Corrosion-resistant alloy jackets have been used on rams, but they are more costly and do not seem to produce any better results.

A molding press is usually designed on the basis of a safe stress within the elastic limit of the material being used. However, the top platen and sometimes the moving platen should be designed not so much with regard to strength as to deflection. Excessive deflection will distort the mold and result in errors in the dimensions of the molded parts. There is also a possibility of damaging the mold. A deflection of 0.006 inch, based on a uniformly distributed load, is permissible.

To obtain the greatest production, a molding press should be as simple in design as possible and as flexible as is commensurate with simplicity of design. Since no one can predict possible changes and trends in molding technique, molding presses should be so designed as to permit slight alterations to be made in order to meet changing requirements.

Office of Price Administration Said to Retard Radio Manufacture

According to R. C. Cosgrove, president of the Radio Manufacturers' Association, which includes 88 per cent of America's radio-manufacturing industry, many American radio manufacturers will be seriously delayed in resuming manufacture of civilian radio equipment, and some radio manufacturers may not be able to resume peacetime production at all, if the Office of Price Administration persists in its policies regarding a post-war pricing formula in this field. Mr. Cosgrove said that the OPA has consistently refused to consider many of the elements of cost.

* * *

Despite the generally higher average of pay rates in the Maritime Commission shipyards over those paid during the previous war, the average cost per deadweight ton in recent years has been $160, compared to $210 in 1918.

Hard at Work Somewhere in the Pacific in the Floating Machine Shop of the First Aircraft Repair Unit, Milling a Part for a B-29 Superfortress. The Operator, S/Sgt. Manuel R. Bustamante, is One of Hundreds of Highly Skilled Mechanics in This Unit who have been Helping to Keep Island-based Planes in the Air (Photo by Courtesy Air Technical Service Command)

Surface Broaching Simplifies Machining of Valve Rocker Arms

By HARRY H. GOTBERG, Chief Engineer
Colonial Broach Co., Detroit, Mich.

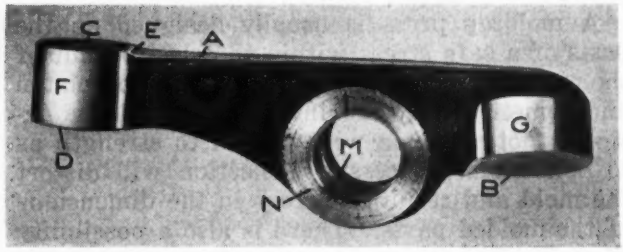


Fig. 1. Valve Rocker Arm of Aircraft Engine on which Surfaces A, E, B, C, D and Cylindrical Surfaces F and G have been Finished by Broaching

ALL major machining operations on valve rocker arms for aircraft engines like the one shown in Fig. 1, with the exception of boring hole *M* and facing sides *N*, are being performed by one manufacturer on dual-ram vertical surface broaching machines such as shown in the close-up view, Fig. 2. The operations include broaching the large flat surface *A* and the 1/4-inch radius *E* in one pass of the broach; straddle-broaching the flat parallel faces *C* and *D* in one operation, and broaching the flat face *B* in another operation in such a manner that the finished surfaces will be in the specified angular relationships to each other; and broaching the cylindrical surfaces *F* and *G*.

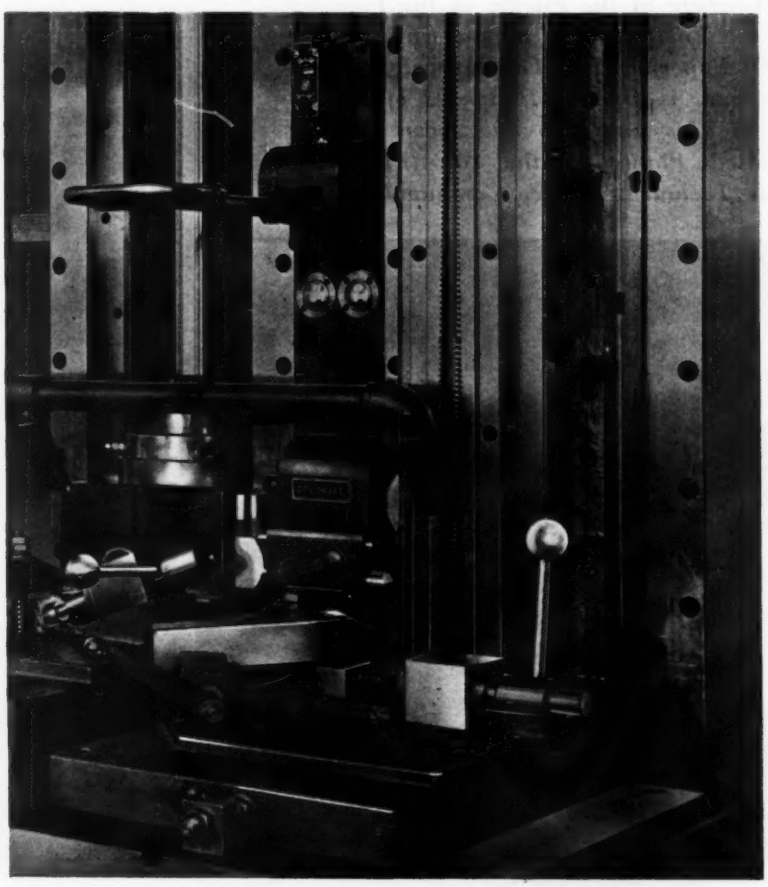


Fig. 2. Close-up View of Colonial Dual-ram Surface Broaching Machine Equipped with Work-holding Fixtures and Broaches for Finishing Cylindrical Shaped Surfaces F and G, Fig. 1

Five Colonial dual-ram surface broaching machines, arranged in a U-shape, are used to machine the various surfaces on the right- and left-hand rocker arms in ten different operations, five operations being performed on each arm. Each broach takes roughing and finishing cuts. The Model VAD broaching machines employed all have a 5-ton rating and a 54-inch stroke, the machines handling the first operation on both the right- and left-hand rocker arms being located at the base of the "U." One ram is used for broaching the right-hand rocker arm, and the other for the left-hand rocker arm.

The first operation on each rocker arm consists of broaching the flat face *A* and the 1/4-inch radius *E* on the top surface of the arm. The fixture is so designed that the flat surface *A* is broached at the correct angle with respect to the axis of the previously machined bore *M* and the faces *N*. An equalizer is built into the fixture which supports both ends of the rocker arm on faces *D* and *B* during the broaching operation. This arrangement consists in locating the flat in such a manner as to equalize metal removal in later operations.

Since the right- and left-hand rocker arms are not interchangeable, the machine rams must be equipped with two sets of fixtures and two sets of broaches. The diagram Fig. 3 shows a rocker arm of the opposite hand from that illustrated in Fig. 1. This diagram indicates how the rocker arm is mounted on a stud *E* to

permit broach *A* to finish the flat surface and radius in the first operation.

After the broaching operation is completed on the first machine, the right-hand rocker arm goes to the group of machines comprising one leg of the U-shaped formation, and the left-hand rocker arms go to the machines in the corresponding position on the other side. Two operations are performed on the left-hand rocker arm in the broaching machine to the left of the centrally located machine employed for the first operation.

In the first ram position of this machine, the bolt boss end is straddle-broached, as shown in the view to the right in Fig. 4, the work being located from the bore and supported by the top flat surfaces previously broached, as indicated at *C*. The bolt boss faces are positioned at a slight angle relative to the top flat. On the second ram, or the ram to the left on this machine, the face on the valve end *A* of the rocker arm (surface *B*, Fig. 1) is broached at still another angle, the work again being located from the bore and bolt boss face *B*, as indicated at the left in Fig. 4, to insure proper angular relationship between the finished surfaces at the two ends of the rocker arm.

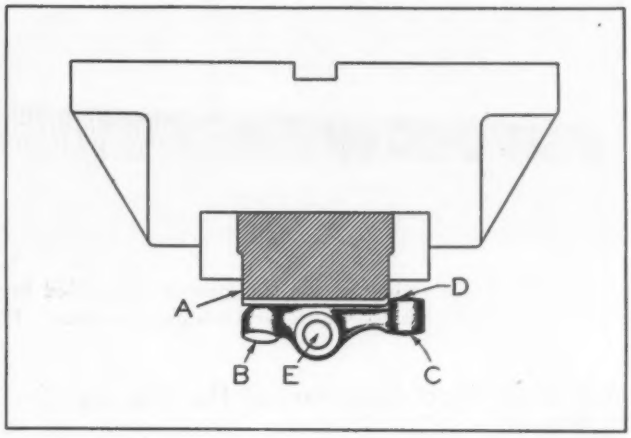


Fig. 3. Diagram Illustrating Method of Holding Rocker Arm while Broaching Surface A, and Radius E, Fig. 1

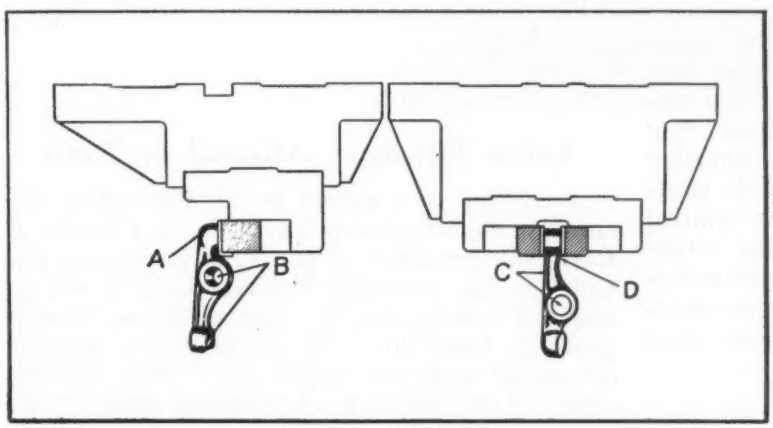


Fig. 4. (Left) Diagram Showing Set-up for Broaching Surface B of Rocker Arm Shown in Fig. 1. (Right) Set-up for Finishing Surfaces C and D, Fig. 1, by Straddle Broaching

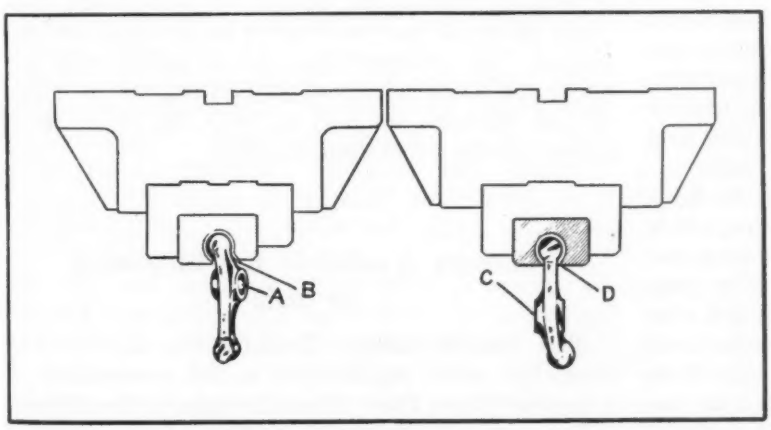


Fig. 5. Diagram of Set-ups for Broaching the Cylindrically Formed Surfaces F and G, Fig. 1

The rocker arm next goes to the third dual-ram machine, where the outside diameter of the bolt boss *F*, Fig. 1, and then the outside diameter of the other end *G* are broached in the manner indicated in Fig. 5. The work is located for the cylindrical broaching operations at *D* and *B* from the previously machined faces *C* and the bore *A*. One external radius is broached on one ram and the other on the second ram of the dual-ram machine equipped as shown in the close-up view, Fig. 2. The semi-automatic control safety handle employed for these operations is shown between the rams of the machine. In this illustration, the right-hand ram is shown in the loading position, the left-hand ram having just completed its cutting stroke.

One-half of one of the two broaches used to form surfaces *F* and *G*, Fig. 1, is shown in Fig. 6. It will be noted that the teeth for forming these ends to a true radius are at the left or finishing end of the broach. Different sections of this broach are individually removable and replaceable. The complete broach is made in two halves like that shown in Fig. 6, in order to permit resetting after regrinding and to facilitate accurate regrinding. One of the complete broaches may be

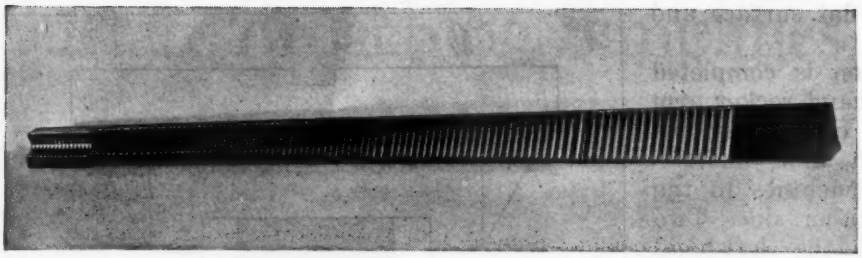


Fig. 6. One-half of the Completely Assembled Broach Shown in Fig. 2 Set up for Finishing Surface F, Fig. 1

seen in the right-hand ram of the close-up view in Fig. 2.

A similar series of broaching operations is performed on the right-hand rocker arm by the machines that comprise the other part of the U-shaped group. General tolerances on the finished rocker arms are around 0.002 inch, with close limits specified on the angular relationship of the various surfaces. The machines are of the automatic cycle type, but are equipped with semi-automatic safety devices.

In operation, the fixture for the right-hand ram, for example, is loaded while the broach for this ram is being returned to the upper position. At the same time, the left-hand ram is performing its broaching operation on the downward stroke. When the left-hand ram reaches the bottom of its stroke, it is shuttled into the loading position. However, this shuttling action is prevented by the safety control unless the operator has his hand on the safety pull-lever. This device permits continuous operation, but at the same time, prevents shuttling of the fixture before loading has been completed.

* * *

Steam Platens Produced by Welding

Temperatures of high uniformity in all surface areas, elimination of hot and cold spots, and efficient heat transfer have resulted from the construction of labyrinth steam platens designed and fabricated by the Lukens Steel Co., Coatesville, Pa. In addition to their use in chemical plants and elsewhere, these platens find application in presses for plastic materials.

The new steam platens may be said to be a rolling mill product in which three separate steel plates are bonded homogeneously into one unit. The outer surfaces are finished by machining, and the inlet and outlet ports are also machined. There are two outside plates and a center plate, which is flame-cut to a labyrinth design. The center plate is tack-welded to the bottom plate to obtain the right position of the labyrinth with respect to this plate. The third plate is then placed on top to facilitate handling during subsequent processes. The total assembly is heated to a welding temperature, after which it is passed through the rolling mill, by which process it becomes one single thoroughly bonded homogeneous plate. The platen thus produced may be treated as a solid plate of steel, which can be bent and formed to shape for drums, molds, heating kettles, or other applications.

A standard inspection test of 1000 pounds per square inch internal hydraulic pressure has been adopted for the testing of these platens. During the development period, however, considerably higher internal pressures were satisfactorily used.

These platens may be made as thin as 1 inch, while their width, length, and maximum thickness are limited only by the capacity of a 206-inch mill in the Lukens plant, which produces plates up to 195 inches wide and up to 25 inches thick. This is believed to be the world's largest plate mill.

* * *

Labor Efficiency Affected by Draft

According to a report to the Packaging Machinery Manufacturers Institute by Charles L. Barr, vice-president of the F. B. Redington Co., Chicago, Ill., covering the results of a survey made of twenty smaller member firms, labor is probably from 20 to 25 per cent less efficient, compared with two years ago. This lost efficiency is attributed to the inroads made by the draft on skilled personnel and to the fact that skilled supervisory staffs have concentrated their best abilities on the production of war materials.

Mr. Barr estimated that for a small business firm to maintain the output of two years ago, from 20 to 25 per cent more labor must be employed. He believes that the situation will improve with the return of skilled supervisors and skilled workers, as well as with the training of a new group of skilled workers.

* * *

Patents Available for Licensing or Sale

The Patent Office, Washington, D. C., has available upon application a list consisting of a reprint from the Official Gazette of the Patent Office, giving a brief description of patents that are available for licensing or sale to interested manufacturers.

Magnetic Inspection in Modern Industry

A Review of the Principles Involved in Magnetic Inspection and of the Methods Employed in the Application of This Type of Inspection at a Well-known Aircraft Plant

By EARLE D. WILCOX
Lockheed Aircraft Corpn.
Burbank, Calif.

Fig. 1. Magnetic Inspection Machine of Welded Steel Construction Employed for Small Parts

THIS article explains the principles of magnetic inspection for the benefit of those not familiar with this valuable and efficient means of discovering defects in the structure of the materials from which parts used in the mechanical industries are made, and outlines the procedure followed in obtaining successful results by this method.

Like a great many other scientific discoveries, magnetic inspection came quite by accident. In 1917, Major William E. Hoke of the Bureau of Standards noticed that during the lapping of precision blocks held by a magnetic chuck it was possible to reveal cracks with magnetic particles. Research was carried out with this "longitudinal" inspection method and some equipment developed. Utilizing this method, such parts as axles of railroad equipment, turbine blades, etc., were inspected. Little else was done for several years.

It was not until 1928 that what is known as circular magnetism was developed. Dr. DeForest of the Massachusetts Institute of Technology was searching for a satisfactory method that would locate longitudinal defects in drill pipe. To the unsatisfactory procedure then used, he contributed the use of circular magetism. This was a very important contribution, and was one of the key factors in establishing recognition of the process. Dr. DeForest also had a great deal to do with the perfecting of the indicating medium and the development of commercial equipment for industrial use. The Army Air Force Materiel Branch at Wright Field was instrumental in bringing this inspection method to its present state of development. In 1941, the various technical publications attempted standardization, and recommended standards were first published in the 1941 S A E Handbook.

For years, physical testing and metallographic examination have been the tried and proved methods for showing the qualities and properties of the metals of industry. Obviously, it would be practically impossible to test every piece of material used by these methods. If the test were destructive, the probable performance of the part in service might be predicted. However, whether similar parts would behave in the same manner is problematical. Therefore, an inspection method that could detect damaging defects non-destructively was greatly desired. This is the primary value of magnetic inspection, as the test may be applied, not only to the finished part, but also to the billet, bar stock, casting, or forging, and as a check on various processing operations such as heat-treatment,

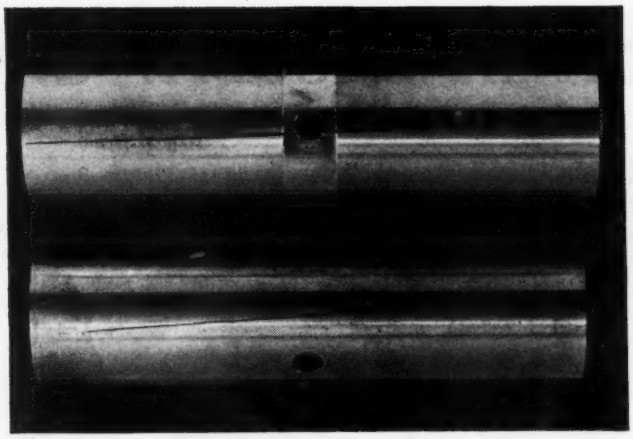


Fig. 2. Magnetic Inspection Indications on a Chromium-plated and an Unplated Pin. The Iron Oxide Deposited in a Thin Line along the Pins Indicates the Presence of a Longitudinal Seam in the Material

machining, grinding, etc. The author considers it in several instances superior to X-ray, gamma ray, etching, or magnetic analysis for rapid, dependable, and sensitive testing of ferro-magnetic materials.

Whether the defect is inherent in the steel, introduced in manufacture, or caused in service, it is easily and quickly detected by magnetic inspection. In some cases, it is the only known method of non-destructive testing that will locate these defects.

The actual operation is relatively simple, and while a basic metallurgical training is required to assist in the proper interpretation of the test results, anyone with average intelligence and the desire to study can make use of this method of testing.

Circular and Longitudinal Methods of Magnetic Inspection

The machines used for magnetic inspection are generally of two classes: Rectified alternating-current types and storage battery types. The main object is to provide direct current for use in magnetizing the parts and assemblies to be tested. Two methods of magnetizing are utilized in these machines. They are known as circular and longitudinal methods.

The circular method consists of magnetizing a part by passing an electric current through it, thus creating an electric field around it. This is demonstrated simply by what is known as the "Right-hand Rule:" "If you grasp the part being magnetized with the right hand, the thumb pointing in the direction of the current, the fingers will point in the direction of flow of the magnetic lines of force." This rule can be used for both circular and longitudinal magnetizing.

The magnetic inspection machines are of welded steel construction in bench form. (See Fig. 1.) One fixed and one movable head operate on rails. The movable head can be adjusted to any position on the rails and locked. The two heads carry the lead-faced copper contact plates for achieving circular magnetism.

Magnetic Testing by the Circular Method

To circularly magnetize a part, the piece is placed between the two heads securely, and a high-amperage low-voltage current is passed through the part for approximately one-half second. As the electric current passes through the part, a magnetic field, consisting of lines of force, builds up at right angles to the direction of flow of the current, surrounding the part and flowing through it as well. This magnetic field rearranges the molecules that make up the internal structure of the part in such a manner that a magnetic charge is carried. In case a crack or other discontinuity is present at any angle to the lines of force, north poles will be formed on one edge of the crack and south poles on the other. As north and south poles are attracted to each other, a magnetic arc is formed. This is to say that lines of force flow between the north and south poles.

Now, if a magnetic substance such as iron filings or iron oxide (ferric) is introduced into this

Fig. 3. Magnetizing a Welded Part by the Circular Continuous Method

Fig. 4. Induction of Circular Magnetism in Hollow Parts by Stringing Them on a Copper Rod. In the Rear, a Woman Inspector Examines Parts that have been Magnetized in a Solenoid

arc, it will be held there, forming a bridge, because of its attraction to the magnetic force. Black iron oxide (Fe_3O_4) is used in magnetic inspection. This, when held in a crack or discontinuity, shows the discontinuity outlined in black. (See Fig. 2.) Red oxide may also be used, giving a red indication.

An interesting fact about circular magnetism is that the magnetism within the part always has a complete ferro-magnetic return path. In other words, a part that is circularly magnetized does not give any definite evidence of being magnetized; it will not pick up other pieces. This can be demonstrated simply by circularly magnetizing a hardened steel washer and noting that it has little or no magnetic effect. Now cut or break it in two. Both pieces will have become a strong horseshoe magnet. This is due to the fact that in breaking the washer, the completed magnetic circuit is interrupted, creating leakage fields that must travel from north to south —exactly the same thing that occurs when a discontinuity is present in a part.

Testing by the Longitudinal Method

The equipment mentioned provides a coil for longitudinal magnetism. This coil is movable on the rails and can be locked in any position. The longitudinal method consists of placing the parts in a solenoid (coil) through which a direct current is passed for a fractional part of a second. This high-amperage low-voltage current, in passing through the coil, creates an induced magnetic field at right angles to the direction of current flow. This magnetic field passes through the inside space of the coil in one direction only, and in encountering the object to be magnetized, it rearranges the molecules of the part in such a manner as to form a north pole at one end and a south pole at the other.

Applications of Longitudinal and Circular Magnetizing

From the foregoing discussion it can readily be seen that longitudinal magnetizing is primarily used to locate transverse defects. These defects are usually caused by forging operations (as, for example, bolts with upset heads), fatigue under repeated stress, and operations such as heat-treating, machining, welding, grinding, etc. The most common flaws in steel, however, are found to be directed longitudinally—that is, in the direction of rolling or forming. Such flaws are present in all steels to some extent. They are caused during the manufacture and processing, and usually cannot be shown by longitudinal magnetization.

Circular magnetizing (creating lines of force

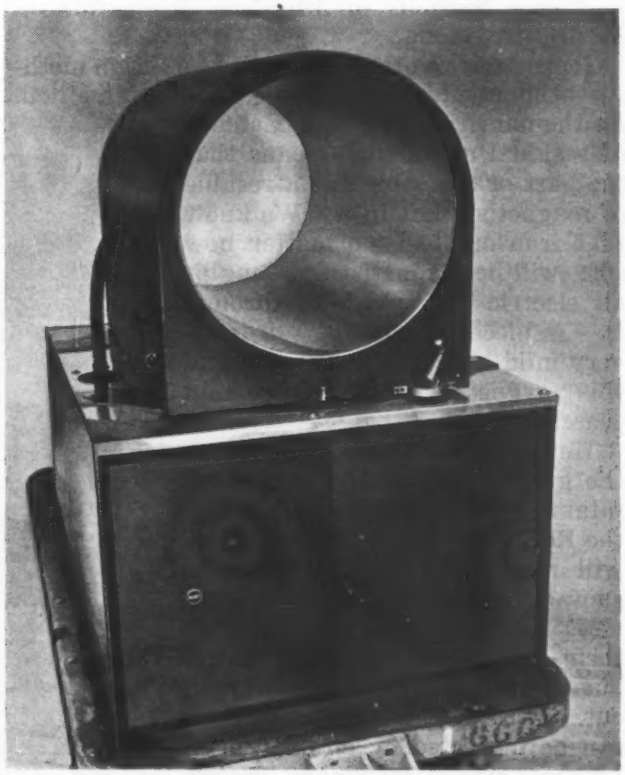


Fig. 5. Demagnetizer Used in Aircraft Plant on Engine Control Stands, Rudder Torque Tubes, etc.

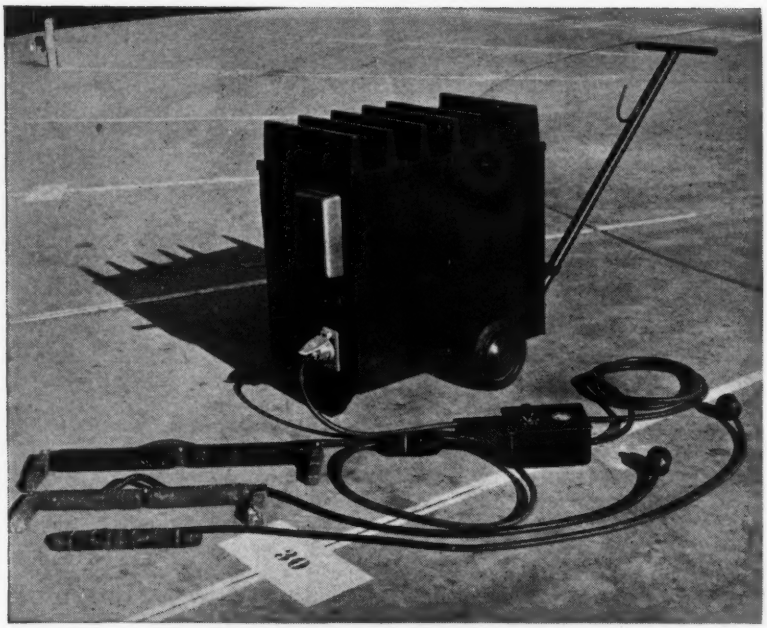


Fig. 6. Demagnetizer of the Yoke or Bi-polar Type

at right angles to the longitudinal type of defect) brings out indications very strongly. It has been our experience that circular magnetization will locate practically any defect. While it may not show transverse defects completely, it gives sufficient indication to warrant further investigation, using longitudinal magnetization.

Other Methods of Magnetic Inspection

There are two other magnetic inspection methods—the residual and the continuous method. As the name implies, the existence of residual magnetism means that the part or assembly has a residue of magnetism left in it. We know that iron or steel, no matter how soft, will be magnetized as long as an electric current flows through it. A piece of dead soft iron or very mild steel will retain none of this magnetism once the current ceases to flow.

However, the harder the steel, the greater is its capacity for retaining magnetism. Steel parts in the Rockwell range of C-25 to C-40 will retain enough magnetism to show cracks when the ferro-magnetic particles are introduced on them. Sub-surface defects, if buried too deep, will not be brought out. Parts such as nuts and bolts can be inspected by circular magnetism, many rejectable defects being found on this basis. This, of course, does not apply to special machined bolts and highly stressed parts, which require further consideration.

In the continuous method, while the current is passing through the part, the solution containing the suspended iron oxide is flowed over it and removed just before the current ceases, to avoid washing off any fine indications. The magnetic field is strongest while the current is flowing through the part, since a part is capable of acting as a conductor of a greater number of magnetic lines of force than it can retain as a magnet. Therefore, the continuous method is used in the majority of cases.

Maintenance of Magnetic Testing Machines

Equipment used for magnetic inspection, like all precision machines, must be serviced regularly, in order to obtain the best possible results and the longest life. In fact, machines of this type must be checked every day they are in use—preferably two or three times a day. The man operating a machine can usually tell almost at once if there is anything wrong with his unit merely by "shooting" it once or twice.

The contact plates must be kept clean of coatings of oxide to insure good contact. A wire brush is used for removing this matter. The plates are of a special Lockheed design—antimony lead, 1 inch thick. The plates now in use

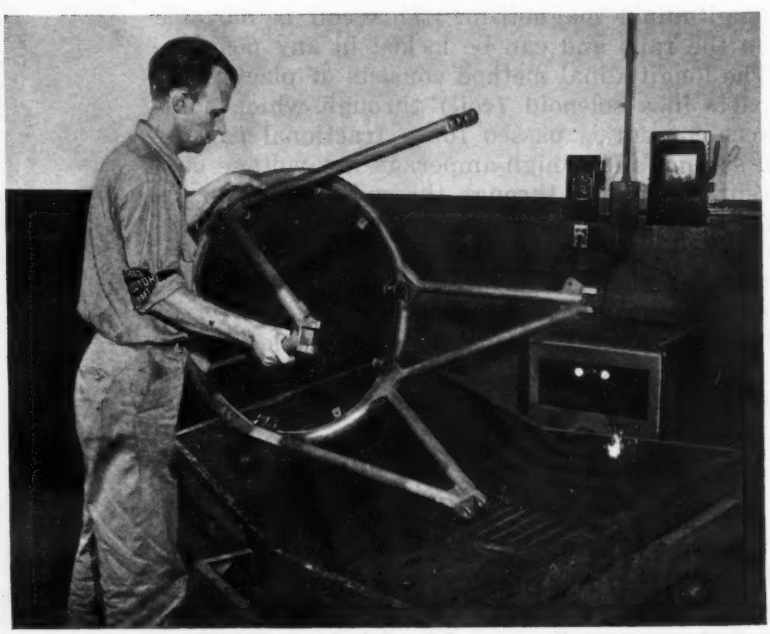


Fig. 7. Demagnetizing Motor Mount on a Table-top Demagnetizer after Magnetic Inspection

have been in service for over two years, as contrasted to the bi-monthly turnover of standard type plates.

The sump screens must be cleaned every few hours, preferably at the start of each shift. The screens are a "storehouse" of lint, chips, filings, and other particles. Unless the screens are watched carefully, serious damage may occur, especially to the pump and impellers.

Pumps, transformers, and other electrical units should be checked daily, preferably by a competent electrician. In the case of battery-operated machines, a maintenance man should check the batteries daily with a hydrometer, and add distilled water as required. He should also check the charging rate and adjust it to the requirements of the batteries. The operator, in taking care of the batteries, must keep the following in mind: The electrolyte (acid solution in the battery), at 80 degrees F. should have a specific gravity (hydrometer reading) of 1.272 or over, preferably over 1.300. Distilled water should be added to keep the solution level 1/2 inch above the top of the plates.

Another point to remember is that the fewer "shots" you take to magnetize a part, the easier it is on the machines. Ordinarily, a part is "shot" only once, or twice if it is not possible to cover the part with solution while the current is on.

It might be noted here that in using circular magnetism, a good rule is to employ approximately 1000 amperes per inch of diameter of the piece. Too much amperage may burn the part, show pseudo-indications, and drain the life from the machine. A study of the amount of amperage to use is very important.

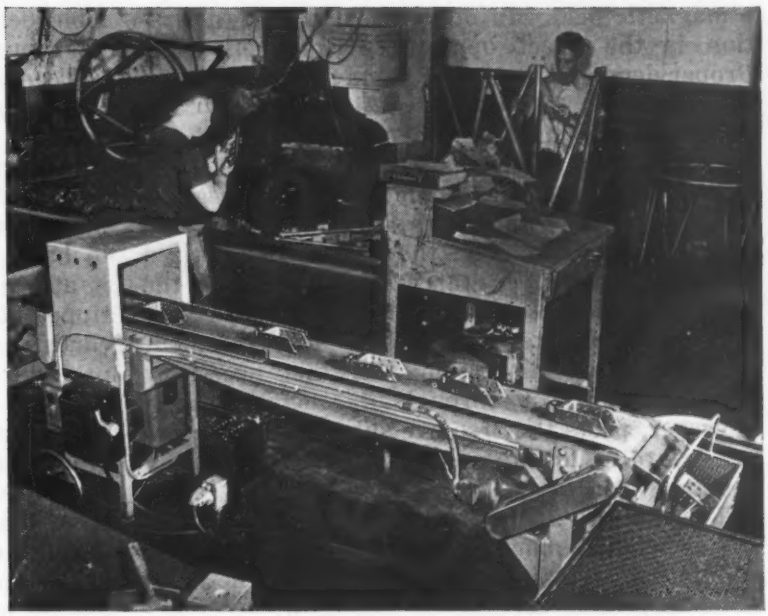


Fig. 8. Continuous Conveyor-belt Type Demagnetizer

Daily Care of Machines

1. Check pumps, motors, rectifiers, etc., to see that they are not overheated and are in working order. Listen for any out-of-the-ordinary noises.
2. Check oil solution for density.
3. Clean sump screens after turning off the pumps. (This prevents material in sump from getting into pump intake.)
4. Clean plates. Wash excess oxide from top of machine into sump.
5. Clean foreign matter from top of machine.
6. Check batteries and charger (if used on machine).
7. Check sump for accumulation of sand and other material. If dirty, drain oil and clean out sump. Wash down sides of machine; flush out system. Filter used oil through 100-mesh screen and re-use. Salvage all oxide possible by "decantation" washing.

Fig. 9. Magnetometer Employed for the Control-checking of Demagnetizing Equipment

Demagnetization after Testing

Demagnetization is the process of neutralizing or "taking away"

a magnetic field. In other words, demagnetization is the exact opposite of magnetization. Proper demagnetization of parts flowing through the magnetic inspection section is very important, and should receive careful attention on the part of magnetic inspection personnel.

Demagnetization is conducted in the regular line flow. After the parts have been inspected and found satisfactory, they are demagnetized and washed. Proper stamps are then put on the parts and they are routed.

If parts are to receive any heat-treatment after magnetic inspection, it is not necessary for them to pass through the demagnetizer. However, parts that require subsequent machining or are to go into assembly must be properly demagnetized.

The Lockheed Magnetic Control Laboratory has developed much specialized demagnetizing equipment. This equipment is used in the magnetic inspection section, as well as at other demagnetizing stations throughout the factory.

The precision assembly department is also furnished with a specially built demagnetizer, as shown in Fig. 5. This coil is supplied from the 480-volt power circuit, which is reduced to 120 volts by an insulating transformer. The power is controlled by a water rheostat which is brought into the circuit by pressure on a foot-lever; when released, the rheostat automatically returns to zero. There are approximately 200 turns of No. 6 wire in this 20- by 40-inch helical coil; the maximum current is about 100 amperes.

Methods of Demagnetization

Demagnetization can be accomplished by the following means:

1. By passing an alternating current at line frequency through the part and gradually reducing the current to zero. The current is reduced by either slowly removing the part from the field or automatically causing the field to reduce while the part remains within the unit.
2. By passing an alternating current at special frequency through the part and reducing the current to zero. This low-frequency demagnetizing is used on large structures, such as landing gear, where the cross-sectional area is great and the material is highly heat-treated.
3. By passing direct current through a part, accompanied by reversals of direction of current, reducing the current gradually to zero. This requires a specialized piece of equipment.
4. By the use of the yoke or bi-polar method. With this method, two opposite poles are attached to the parts and the field passes from one pole to the other, gradually reducing the current to zero. (See Fig. 6.)

Even while demagnetizing a part, the earth's field has a certain amount of magnetizing effect on the part. Therefore, to obtain the best possible demagnetization, the effect of the earth's field must be eliminated.

To do this, we must first have the part to be demagnetized in a position at right angles to the lines of force of the earth's field, and also at right angles to the direction of flow of the earth's field. The demagnetizing equipment is placed on an approximate East-West line, so as to have the earth's magnetic field cut through it at right angles. It is also capable of being tipped 30 degrees to avoid any possibility of the earth's magnetic field threading through the part during the demagnetization cycle.

When it is necessary to have a part demagnetized as much as possible, and when the part is multi-axial, the angular relationship referred to is used. In this case, it is necessary also to have a field generated within the equipment to counteract the effect of the earth's magnetic field. In the large table-top demagnetizer for use on motor mounts, bays, landing gear, etc., a coil is built through which a direct current is passed, creating a field in the opposite direction to that of the earth's field. (See Fig. 7.) This field may be varied to exactly counteract the effect of the earth's field. The alternating demagnetizing current then is utilized to full advantage.

Other Equipment Required

The solenoid types of demagnetizers used in connection with magnetic inspection are also specially designed units. All the small parts passing through magnetic inspection flow through a continuous type demagnetizer by means of a conveyor-belt system (Fig. 8). This greatly speeds up the work, gives much better demagnetizing results, and eliminates excessive handling of parts.

The larger demagnetizers, such as the table top type previously described, the armor plate demagnetizer, and the solenoid type used in precision assembly, all have specially built power units that automatically reduce the alternating field to zero while the part remains within the unit. The decreasing alternating field is controlled by means of an electrolytic rheostat which enables the current to quickly reach a maximum and then gradually be reduced to zero. The demagnetization cycle takes about six seconds.

It is also desirable to have a Magnetometer for the control-checking of all the demagnetizing equipment and accessories (see Fig. 9).

Defects Located by Magnetic Inspection

Among the parts that can be easily and advantageously inspected magnetically are bolts. The following defects are usually found in bolts by this type of inspection: Longitudinal inclu-

sions or cracks, seams, metal torn during the forging operation, and transverse cracks at the junction of the head and the shank. The most common defects found in nuts by magnetic inspection are longitudinal cracks; to detect these, circular magnetism is used.

In forgings, the most common defects are inclusions present in the original billet; cracks due to forging at too low a temperature or with too severe blows; laps where the metal has folded over, but has not been welded to the main body of the forging; and flash-line cracks. The forging flash is very thin and cools very rapidly; when trimmed off, cracks may be caused at the flash line.

In castings, the most common defects are blow-holes; cracks found where there is a change of section or cracks due to unequal cooling, poor mold design, or neglect to anneal the casting to relieve severe internal strains; cold-shuts caused by metal splashing against the mold wall, solidifying and remaining separate from the solidified metals; and inclusions.

* * *

New Type of Brake Blocks

A patented brake block known by the trade name "Key-Lok," which is claimed to possess quick replacement features, is being manufactured by the Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J. This development was undertaken to gain advantages over the conventional bolt type method of attaching brake blocks. The improvement consists of lateral "fish-tail" metal strips or "keepers" in which bolts are inserted, spaced to fit in the brake bands. These "keepers" slide into fish-tail slots cut in the block. It is stated that by this means the bolts, bands, or shoes never need be removed when relining. All that need be done is to loosen the "keeper" nuts slightly, slide off the old and slide on the new lining, tighten the bolts, and make the normal adjustments.

* * *

Tubing Pressure Chart

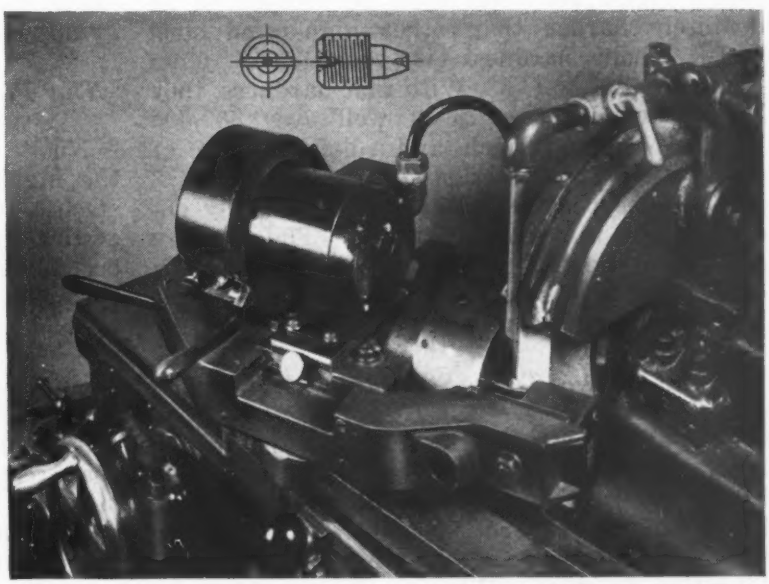
A chart designed to show the safe working pressure for round steel tubes with outside diameters up to 10 inches, wall thicknesses of from 0.035 to 1 inch, and an ultimate tensile strength of from 40,000 to 100,000 pounds per square inch, has been made available to industry by the Baker Steel & Tube Co., Los Angeles, Calif.

Equipment for Grinding Conical Surfaces on Small Pivot Screws

To obtain maximum accuracy with respect to roundness and concentricity in grinding conical surfaces on small pivot screws, the Brown & Sharpe Mfg. Co., Providence, R. I., recently designed the special equipment here illustrated for use on its No. 5 plain grinding machine. The 40-degree angle cone point of the pivot screw outlined near the top center of the illustration is ground with this equipment by rotating the work on dead centers, utilizing small center holes, the drive being accomplished by means of a tongue on the dead center pulley which engages a slot in the end of the pivot.

The dead-center headstock and footstock of the special unit can be swiveled to a greater work angle than that provided by the swiveling table of the machine. This assures permanent alignment of the headstock and footstock centers. Since the footstock center is fixed in relation to the grinding wheel, the diameter of the work at the end of the tapered surface remains constant. The headstock is equipped with a sliding center which is held in the forward position during the grinding operation by spring pressure, and is withdrawn by a lever to permit loading and unloading the work.

The grinding is done by the plunge-cut method. The work produced is uniformly accurate with respect to roundness and concentricity, and has a high finish. Sufficient adjustment of the footstock is provided to accommodate a wide range of work. Adjustments for the taper angle can be readily made to suit requirements. A hole is provided in the footstock bracket for the truing diamond holder.

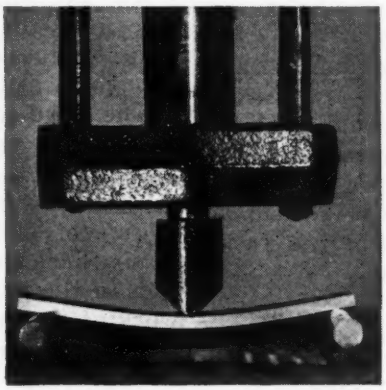


Plain Grinding Machine Equipped for Grinding Conical Surfaces on Small Pivot Screws

Application of Nusite—A Specially Heat-Treated High-Speed Steel

By ARTHUR A. SCHWARTZ
Chief Tool Research Engineer
Bell Aircraft Corporation, Buffalo, N. Y.

WITHIN recent years, a specially heat-treated high-speed steel known as "Nusite" has been made available to the machine shop industry. The development of Nusite is the result of extensive research carried out by a group of men headed by W. S. Nusbaum, of Nusite Steel Process, Warsaw, Ind. The cobalt content of this steel is about 13 per cent. Through a series of low and high heat-treatments used in sequence, transformations in structure are obtained that give this steel unusual properties. An atmosphere control has been developed which eliminates decarburizing.



Showing how a Nusite 3/16- by 5-inch Cut-off Tool with a Hardness of Rockwell C 67 Bent 0.308 Inch before Breaking

The writer obtained some samples of this material about two years ago, and after laboratory tests, this steel was adopted for use in the three Bell Aircraft factories. Our experience with Nusite has been satisfactory. We have found high-speed steel tools so treated to be definitely harder than other high-speed steel tools. Their hardness is consistently from Rockwell C 67 to C 68. With that hardness, they have a tensile strength of well over 300,000 pounds per square inch, and a definite trace of elongation. Small sections of about 1/2 by 1/8 inch can be bent sufficiently to be visually observed; and they remain curved. The fracture has a very fine, silky structure, not resembling other steel fractures. The Charpy impact test is 6.1 foot-pounds or better.

How Nusite Tools Should be Applied

Like all other tools, those made from Nusite have advantages and disadvantages. These tools have good resistance to vibration, particularly high-frequency vibration in the supersonic range, but this does not make them proof against vibration fracture. When used as solid tools, such as turret lathe tools, the shanks must be massive, and they should have a cushion of some metal like copper or soft steel both on top and bottom, which, by the way, is now considered good practice on all tools as a vibration cushioner. If the tool is held by a single set-screw on the top, the vibration centered at this screw may fracture the shank in a few minutes. This difficulty is overcome by using tools having soft steel shanks to which are brazed small bits of Nusite.

As to the advantages, we might mention first the additional shock resistance for such uses as shaper and planer tools, and the excellent results obtained on intermittent cuts. The surface of the tool can be finished to be very smooth. There is no cratering, and the coefficient of friction is low. To get the best results, see that there is a very smooth surface, at least on the top of the tool against which the chips slide. A little lapping at this point will pay dividends in tool life between grinds as much as tenfold.

The Place of Nusite among Cutting Tools

Nusite fills a definite need for a tool between the high carbides and the regular high-speed steels. It comes close to the hardness of some of the carbides, and it excels the regular high-speed steels in strength and shock resistance. Obviously, there are some jobs that can be performed better by using regular high-speed steel rather than Nusite, but, as a rule, Nusite serves most requirements. During the hectic years of war production, there has been little time or opportunity for real research into what Nusite heat-treatment might do for various other steels, including plain carbon tool steels and chromium-molybdenum steels. However, it has already been ascertained that steels with a high percentage of molybdenum react well to the Nusite treatment.

Some readers will ask for the best feeds and

speeds to use with this cutting tool. Information of this kind the writer refuses to place on record. Too many good tools have been ruined by adhering absolutely to feed and speed tables. There are too many variables to permit an absolute adherence to such tables. The speed range at which Nusite can be applied is comparatively great. The tools can be ground to a very sharp edge, and will retain this sharp edge unless burned.

It is advisable to start Nusite tools at the same speeds that would be used for regular high-speed steels, and then increase the speeds gradually until the tool shows heat colors, which is the signal to slow down to a slightly lower speed. That speed will generally be about 40 per cent greater than the speed used for regular high-speed steel tools.

Because of the great strength of Nusite, the feed can generally be doubled, provided the machine and fixtures are strong enough. Generally speaking, between the increased feeds and speeds, production can be doubled; and because of the longer time between grinds, production can actually be more than doubled.

A few precautionary remarks may not be out of place. In cases where carbide tools are used to advantage, it should not be expected that Nusite will equal or exceed the production obtained. If, however, difficulties are experienced with carbide tools, particularly on "long chip" steels, Nusite may be the tool material best suited for the job.

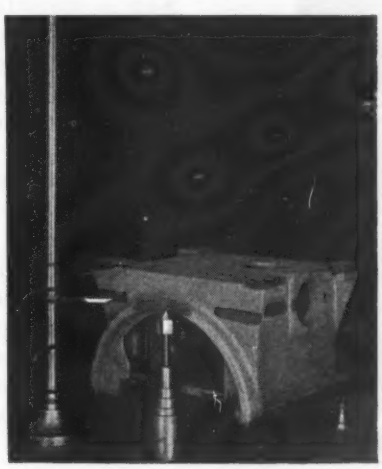
Another note of caution is this: Very good dies and punches have been made from Nusite, but there have also been some failures. Use Nusite for this purpose only when extra strength and low friction are necessary for economical operation. For form tools, Nusite has set some good production records in our plants. In jobbing shops and in shops with limited production runs, Nusite and Tantung—one of the Stellites—will be found especially advantageous.

Great developments have taken place in all types of cutting tools during the war. Each type of cutting tool fills a definite place in the production routine, and it is believed that a frank discussion of the advantages and disadvantages of each type will prove of benefit to users and makers of tools and tool materials.

Multiple Height Gage Simplifies Lay-Out and Inspection Operations

A MULTIPLE height gage, designed by Charles Rohlfs of the inspection department of the General Electric Co.'s Pittsfield Works, has simplified the scribing of gear housings and their inspection after machining, as well as provided a means for considerably reducing lay-out time. Dial indicators can be clamped to the multiple scribers and set to the dimensions required for inspecting quantities of identical parts. The gage is relatively simple to make, since it consists primarily of a center column threaded into the base and secured by a lock-nut, and hardened and ground spacers and scribers drilled to a slide fit on the column on which they are assembled, as shown in the accompanying illustration.

The spacers are ground to dimensions that will accurately position the scribers for the lay-out lines to be scribed on the work. After the spacers are placed on the rod and correctly positioned, the assembly is secured by a cap-nut. To compensate for the variations in unmachined castings, the complete assembly of spacers and scribers can be adjusted to a higher or a lower position, without disturbing any of the intermediate scribers, by loosening the lock-nut and screwing the center column rod into or out of the base as required. By using a set of spacers for each lay-out job, the scribers can be easily spaced and secured for laying out any number of identical parts. This new gage eliminates the use of the conventional type gages, which require setting for each line.



Multiple Height Gage Designed to Simplify Lay-out and Inspection Operations

* * *

The fact that the orders received by the Westinghouse Electric Corporation, Pittsburgh, Pa., in the first half of this year increased 13 per cent over the same period of 1944 is an indication of post-war planning by industry, which promises active post-war demand.

Engineering News

Altitude Chamber that Simulates the Ascent of a Plane to 70,000 Feet

One of the best equipped altitude chambers in this country, if not in the world, is located at Willow Run, Mich., and is being used by the test branch of the equipment laboratory of the Air Technical Service Command. This chamber can simulate the ascent of a plane to 70,000 feet, and has a temperature range down to 100 degrees F. below zero. This is approximately the coldest stratosphere temperature on record. Designed for either automatic or manual control, this chamber can maintain automatically the conditions of any set altitude within a 22-foot range, and can hold for two weeks any given temperature within 2 degrees F. At the same time, it is capable of undergoing a temperature change of from 70 degrees F. above to 70 degrees F. below zero in eight minutes, and will adjust itself to rates of ascent as high as 7500 or descents of 25,000 feet per minute.

A Hardness Testing Hammer for Portable Use

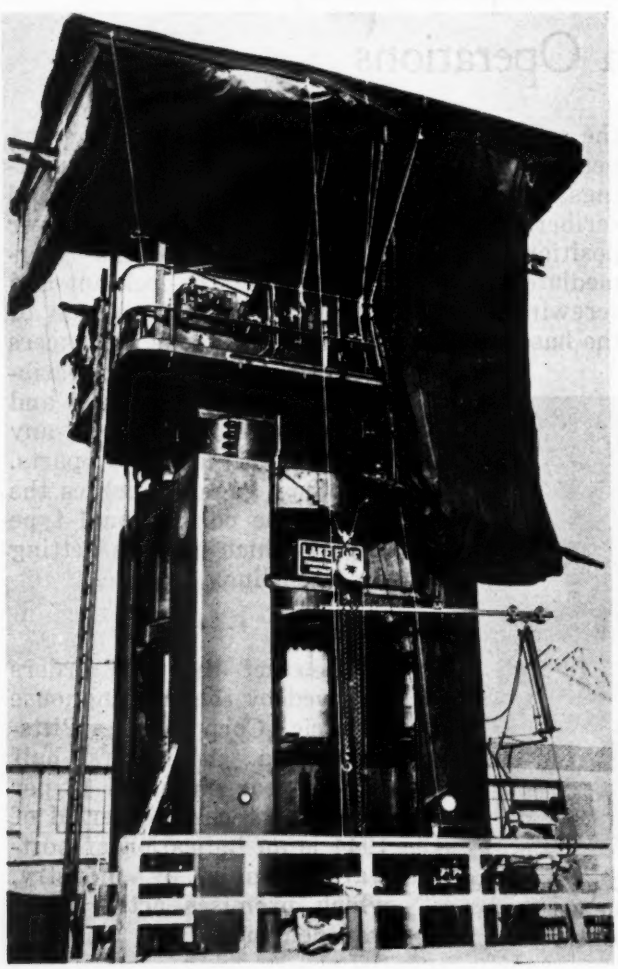
An instrument that makes it practicable to make a hardness test wherever the material is located in the shop, in the yard, or on a truck or railway car, instead of taking the specimen to the testing machine, has been developed by the Steel City Testing Laboratory, 8843 Livernois Ave., Detroit 4, Mich. It is known as a portable hardness testing hammer. With this device, the hardness, as far as it affects the workability of the metal, can be determined quickly, even by unskilled labor. If material of a certain degree of hardness is to be selected, it is only necessary to see whether the diameter of the impression made by the hammer corresponds to the desired degree of hardness. If the impression is smaller or larger, the specimen is either too hard or too soft.

A Giant 6000-Ton Hydraulic Press with Total Height of 43 Feet

The press shown in the accompanying illustration, having a total weight on the foundation of 500 tons, and a capacity of 6000 tons, was built by the Lake Erie Engineering Corporation, Buffalo, N. Y., for the Norris Stamping & Mfg. Co., Los Angeles, Calif. This press was much too large to be erected in any of the Norris Co.'s buildings constructed up to the time of its installation. Hence, it was erected outdoors in a lot adjacent to one of the buildings of the Norris manufacturing plant.

When placed in operation, the press was covered with a temporary protective tarpaulin covering until a suitable building could be erected around it. The foundation pit, which is 15 feet deep, was started on December 1, 1944, and the entire press was in place on January 25, 1945. Credit for the speed of erection goes to the Norris Stamping & Mfg. Co., who did the entire construction job under the supervision of a service engineer from the Lake Erie Engineering Corporation.

The weights and dimensions of some of the parts may prove of interest. The bottom platen weighs 80 tons; the moving platen 70 tons; and



A Giant Press that Extends 32 Feet above and 11 Feet below Floor Level to the 15-foot Deep Foundation

Looking along One of the Manufacturing and Assembly Aisles at the Westinghouse East Pittsburgh Plant through a Generator Frame of Huge Proportions

the top cylinder 108 tons. The four columns are 22 inches in diameter by 34 feet long, and weigh 6 tons each. The main ram weighs 22 tons, and each of the four guards weighs 1 1/2 tons. The four columns are really enormous studs, threaded on each end for giant nuts.

The power is provided by a 250-H.P. motor. Not less than 3300 gallons of oil are required to fill the tank for the hydraulic system. The height of the press above floor level is 32 feet. It extends 11 feet below this level to the foundation. Eight flat railroad cars were required to ship the press.

Electronic Sound Gaging Device for Use by the Blind

An electronic sound gaging device that makes it possible to employ blind inspectors has been developed at the bearing factory of the Timken Roller Bearing Co., Canton, Ohio. It enables blind inspectors to gage rolls, cones, cups, and other parts of Timken bearings. A sound indicator is attached to the gage employed. There is a small cone type speaker mounted on the back of the blind inspector's chair and connected with an electronic device. The blind inspector hears three different notes issuing from the loud-speaker. If a part is within the prescribed limits, this is indicated by the sound of the middle note; if the high note is sounded, the dimension gaged is over size; while the low note indicates that it is under size. In this way, a blind inspector can easily separate parts of correct size from those of incorrect size.

Fiftieth Anniversary of X-Ray Marked by Increasing Industrial Use

This year it is fifty years since Wilhelm Roentgen discovered the X-ray. The name X-ray was given to this new electrical manifestation because Professor Roentgen was at a loss to otherwise designate this unknown quantity of great penetrating power. While scientists immediately acclaimed the great discovery, no one at that time dreamed that within half a century Roentgen's invention would be used by industry throughout the world to facilitate inspection of all kinds of equipment—that used in war, as well as that employed for peaceful purposes. In the war effort, X-rays have been extremely important, since through their use it was possible to detect flaws in ordnance before it reached the battlefront. Their use in peacetime production will doubtless be greatly extended.

New Electrode Coating Equipment with Improved Features

Equipment recently developed by the Moslo Machinery Co., Cleveland, Ohio, capable of producing 1000 welding rods per minute is provided with several new features. The machine has a centralized control panel, from which one man can start and stop every operating unit. The compact oven used in connection with this equipment is said to occupy 40 per cent less floor space than has been necessary for similar equipment in the past. It has also an improved mechanism for transferring electrodes in the oven in accurate alignment from one pass to the next. A mixing machine for blending the various coating materials and organic materials is also part of the equipment, as well as a machine that straightens and cuts off the rods to predetermined lengths. A new die-head is used which is said to provide smoother operation and a greater uniformity of coated rods.

Torch-Cutting of Stainless Steel Made Possible by New Equipment

PRODUCTION flame-cutting of stainless steels is a problem that has baffled engineers for years. It has now become possible through a process developed jointly by the Air Reduction Co., 60 E. 42nd St., New York City, and the Rustless Iron & Steel Corporation, Baltimore, Md. Up to this time, one of the limiting factors in the economical fabrication of stainless steels was the lack of an efficient production method for cutting these steels with the oxy-acetylene torch. The very elements that give stainless steels their desirable properties produce oxides when attempts are made to cut them with conventional oxy-acetylene cutting equipment, reducing the operation to a slow melting-away process.

With the introduction of the Air Reduction Co.'s Flux-Injection cutting equipment, stainless steels containing as much as 50 per cent of alloying elements can be cut as readily as ordinary steels. The method has been developed for use with any Airco standard cutting machine equipped with a modified conventional machine cutting torch and a standard tip. For hand-cutting, a torch adapted for use in cutting stainless steel is also available.

The principal factor in the development is the use of a flux in powdered form which is automatically applied in the cutting flame. The Flux-Injection unit weighs about 75 pounds when fully charged.

The operating instructions for cutting stainless steel are approximately the same as for cutting mild steel, and the speed of the cut is the same as for cuts of comparable quality. The flux consumption for cutting thicknesses of 1 to 5 inches averages about 1 ounce per minute of operation. Only normal preheat—the same as required for standard cutting operations—is needed. The process is recommended for quality cuts up to 3 inches in thickness, and rough cuts in greater thicknesses up to 6 inches.

Fig. 1 shows a cut started in a stainless-steel plate 2 1/2 inches thick, the length of the cut being 10 1/2 inches. This cut is made in 18–8 stainless steel in three minutes.

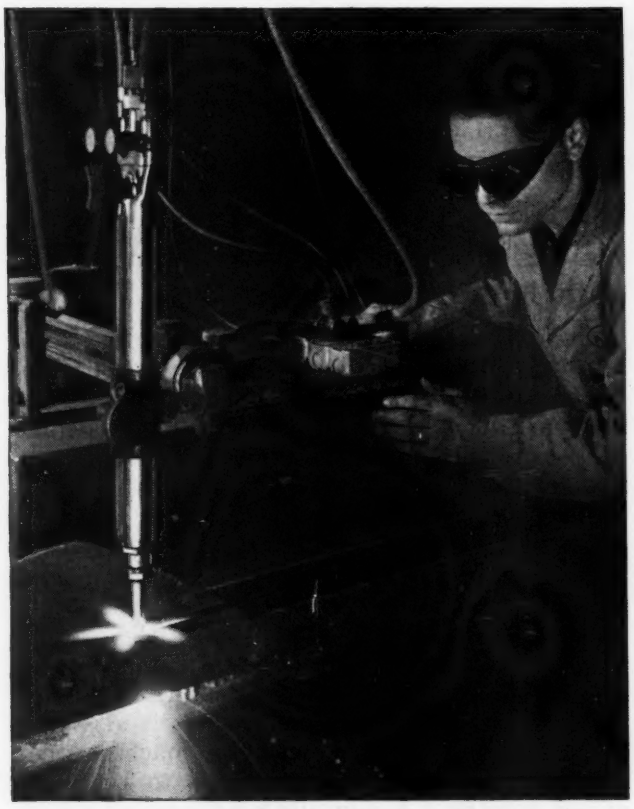


Fig. 1. Starting a Cut in a 2 1/2-inch Thick Section of 18–8 Stainless Steel

Fig. 2. The 10 1/2-inch Long Cut Started in Fig. 1 is Completed in Three Minutes

The Comparoscope—An Optical Instrument for Evaluating Surface Finishes

AN instrument for comparing the finish of a piece of work either with an accepted standard or with another work-piece has been developed by William F. Klemm of the Compar-Instrument Co., 16179 Hamilton Ave., Detroit 3, Mich. This instrument differs to a considerable extent in the principles upon which it is based from the surface finish measuring instruments so far available. It compares surface finishes by optical means, is simple in operation, and gives answers to questions relating to surface finish instantaneously.

The basic principle underlying the Comparoscope is the fact that a light beam thrown at a given angle upon a perfect surface, such as a mirror, will be reflected from this surface at the same angle. If an observer is viewing such a perfect surface in a direction normal to the surface and all reflected light reaching his eye at an angle is shielded from it, no light will reach his eye and the surface will appear black. If the surface has a number of interruptions, such as caused by the various finishing methods, these interruptions will form minute prismatic surfaces, throwing light beams back into the observer's eye. Therefore, the more numerous and wider these surface interruptions are, the brighter such a surface will appear to the eye of the observer who inspects it through the Comparoscope. It is now generally considered that the depth of surface interruptions has little bearing on the actual wear of surfaces.

The instrument is principally a dual microscope, in which an accepted standard or master is clamped in the master section of the instrument. This master may have been determined as having a desirable finish by various methods, or by actual wear tests. The instrument is placed upon the surface to be examined and the built-in illumination of the instrument is turned on. In the eye-piece appear the image of the master and that of the piece being tested. Since the same source of illumination (a condensed filament, 6-volt lamp) is used at an equal distance from both surfaces, the illumination of both images is identical. Photographs taken through the instrument show differences between two surfaces of as little as 1 R.M.S., when checked by equipment that records finishes in R.M.S. units.

One important feature claimed for the Comparoscope is that it places emphasis on, and proves the importance of, the direction of finish in relation to the direction of motion of a part subjected to wear. By placing the instrument in the direction of the intended motion of such parts, the image will give a direct indication of the reaction of such a surface to its mating member. The instrument shows that it is obviously wrong to finish reciprocating parts, such as pistons, in the same direction as rotating parts, such as driving shafts. When parts have been "superfinished," they show the same surface value, regardless of the direction in which the instrument may be placed on the surface. This type of finish will wear equally well, no matter what the direction of motion.

The Comparoscope in Use for Inspecting a Finished Surface

By sliding the knob on the side of the instrument, the image of the master can be eliminated. The instrument can then be used as a self-illuminated shop microscope.

The Comparoscope also offers a means for comparing two apparently similar types of fabrics or textiles. Granular material, as well as paint and pigments in powder form, can also be examined and compared.

The importance of surface finish has been more and more recognized during recent years, and with this recognition have come improved instruments for its evaluation.

Editorial Comment

Now that the war in the East, like the war in Europe, has come to a sudden end, credit for the victory will go mainly in two directions. First and foremost we must give credit to our fighting men on land, on sea, and in the air. The officers and men who planned and carried out all the enterprises that culminated in final victory have displayed marvelous ability and courage. The victory could never have been won except for what these men have done.

However, no armies or navies, no matter how able and courageous their personnel, can achieve results unless they are supplied with the weapons of war at the right time and in sufficient quantities. Hence, credit for the victory must also go to our industries—the industries that, as has so often been pointed out in MACHINERY, in an incredibly short time converted from the production of civilian necessities to the making of the "tools of war."

We Should Not Forget the Contribution of Industry to Victory

To the men of industry—all the way from the leaders and managers to the men operating machines and performing assembly operations—should go the credit they so amply deserve. First, there are the industrial leaders who conceived the possibility of performing unheard-of feats of manufacturing and who entered upon this work with wholehearted enthusiasm. In many cases, they threw overboard all considerations of the consequences to their business and to themselves after the war. They built and equipped factories that they will be able to keep busy only with difficulty in peacetime years. They staked the future of their enterprises on one object—victory.

Next, we must not forget the contribution made by the machine tool builders of the country who produced the necessary war production machines by expanding their output sevenfold, compared with their greatest peacetime production. From an annual peak output valued at about $200,000,000, this industry, within a short space of time, so developed its facilities that it was producing at the rate of approximately $1,500,000,000 a year.

But it is not the leaders and managers of industry alone who deserve credit for what was accomplished in war production. A group of men without whom these results could not have been achieved consists of the thousands of engineers who planned the methods of production and designed the means by which all the implements of warfare were so quickly and efficiently produced, the ships built, and the planes constructed.

Stupendous Job of Tool Engineers and Production Men

In performing their enormous task, they undertook no routine job. Most of the problems solved were new to them, but the results testify to the fact that their experience and ingenuity were equal to the job. Though confronted with applications wholly foreign to them, in a few months they made the wheels in the converted plants turn again, producing long-range guns, aircraft engines, tanks, shells, and fuses in place of all the civilian products they had formerly furnished to a peaceful nation. Many of these engineers, in the earlier days of the war especially, literally worked day and night to complete their tasks in the shortest possible time.

Nor should the millions of workers be overlooked who performed their tasks from day to day without faltering. Especially should credit be given to those skilled workers who faithfully performed their allotted tasks with the full realization of the seriousness of the dangers facing the nation—the men who worked long hours to provide the fighting forces with the equipment needed and who refused to listen to that group of self-appointed leaders of labor who fomented strife and strikes at a time when tens of thousands of our young men were giving their lives for the nation.

Workers who Faithfully Stayed on the Job Did Their Part

Over two years ago, MACHINERY commented: "When the war is over, let us not forget to add to the credit that we shall then give to the leaders of our armed forces and to the fighting men, the credit that is due our industrial leaders and their supervisory staff, our engineers, and the conscientious workers throughout industry." Now that the war *is* over, it is due these men that their services be again emphasized.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Intermittent Feeding Mechanism Designed to Operate Two Slides from One Cam

By L. KASPER

The mechanism shown in the accompanying illustrations (Figs. 1 to 5) was designed to feed a continuous strip of corrugated flat wire stock *W* through a machine for further fabrication. The rapid, positive, intermittent feeding movement required is obtained through the operation of feed-slide *A* and work-gripping slide *B* by a single cam *C*. It is interesting to note that both slides *A* and *B* are operated simultaneously by cam *C* and that slide *B* is mounted in a dovetail groove in slide *A*.

Referring to Fig. 1, shaft *S*, carrying cam *C*, rotates in the direction indicated by the arrow. Stud *D* on slide *A* carries the cam roller *E* and the bellcrank lever *F*, which is free to oscillate. Lever *F* carries on its short arm the roller *G*, which is free to rotate on its stud. Pin *H* is fixed in slide *B*, and passes through the slot in the upper end of lever *F*. Spring *J* serves to hold rollers *G* and *E* in contact with cam *C*. Work *W* is passed through the machine in contact with the guide strip indicated at *K*.

In Fig. 1, both rollers *G* and *E* are shown in contact with the low portion of cam *C*, which holds the slides in a fixed position during the rest period of the cycle. It is during this rest period that the fabricating operations are performed on the work. The formed end of slide *B* engages the corrugations in the work *W* as shown during this dwell period, holding it in contact with guide strip *K*.

Fig. 2 shows the rise or lobe of cam *C* engaging roller *E* and causing slide *A* to move to the rear. Roller *G* has not yet been affected by the action of cam *C*, but the position of lever *F* has been changed so that, in addition to the rearward movement of slide *A*, the action of lever *F* on pin *H* has caused slide *B* to be withdrawn from contact with work *W*. Since the rearward movement of slide *A* is equal to the pitch or center-to-center distance of the corrugations of the work, no rearward movement is transmitted to work *W*. The slide *B*, however, has moved to the rear with slide *A*, and its forward end is in position to engage another set of corrugations in work *W*.

Continued rotation of cam *C*, as shown in Fig. 4, causes roller *G* to rise to the high portion of cam *C*. As roller *E* is in the same rela-

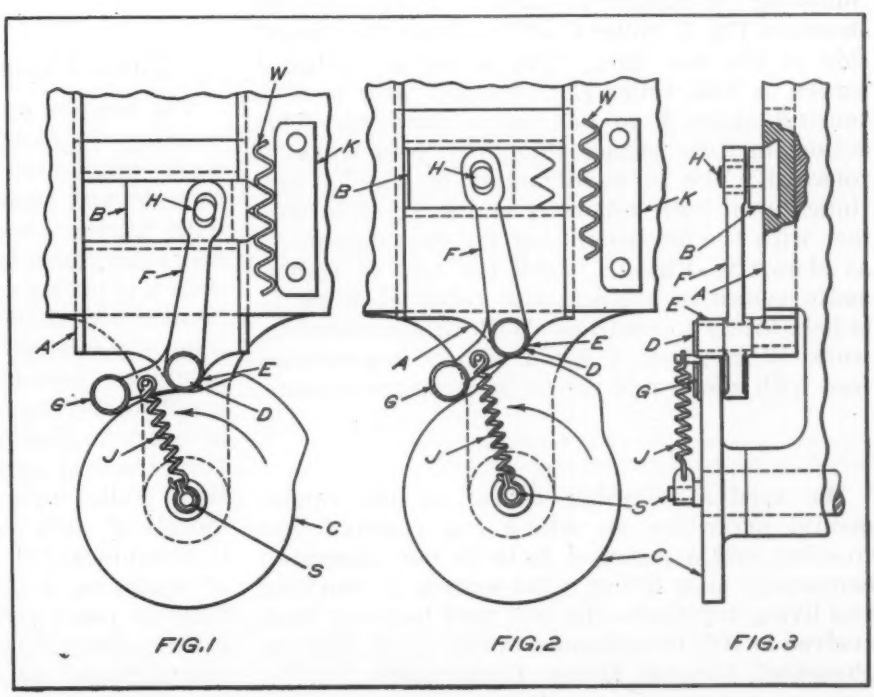


Fig. 1. Mechanism for Intermittent Feeding of Corrugated Flat Wire Stock W at End of Dwell Period in which Stock is Held Clamped against Block K by Slide B. Fig. 2. Slide B Withdrawn from Work W and Slide A Moved to Rear One Corrugation through Action of Cam C. Fig. 3. Side View of Feeding Mechanism

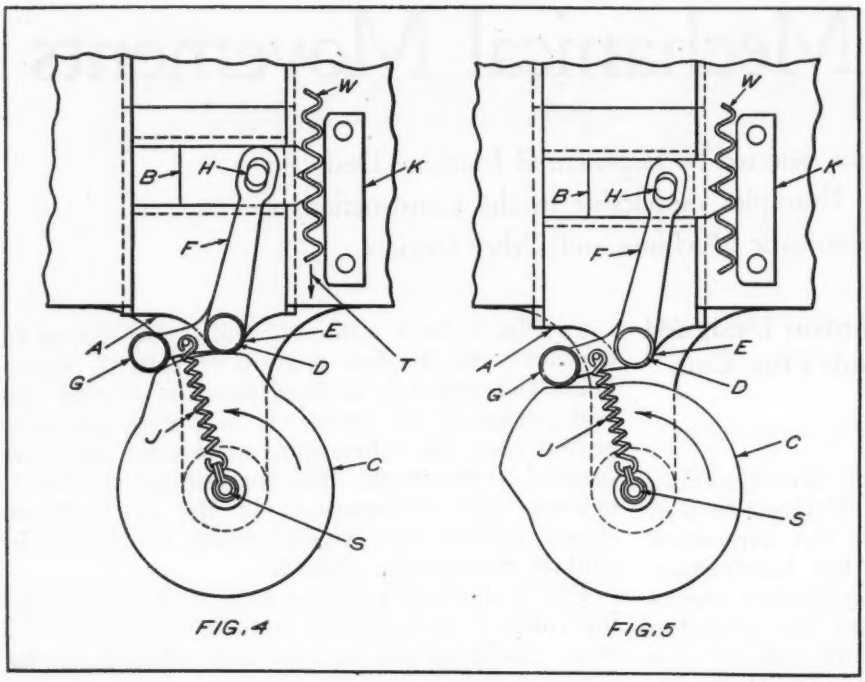


Fig. 4. Slide B Advanced to Engage Work W preparatory to Feeding It Forward in Direction Indicated by Arrow T. Fig. 5. Mechanism Engaged in Feeding Work W Forward, with Cam C Approaching Dwell Position

tive position as shown in Fig. 2, there has been no movement of slide *A*. The change in the position of roller *G*, however, has caused lever *F* to pivot on stud *D*, actuating slide *B* and causing its forward end to again engage the corrugations in work *W*. Comparison of the view in Fig. 4 with that in Fig. 1 shows clearly the changes in the position of slide *B* relative to work *W*.

Fig. 5 shows the mechanism after cam *C* has passed from under roller *E*. The pressure of slide *B* on work *W* against guide strip *K* at this stage of the operating cycle prevents any movement of lever *F* and also prevents roller *E* from following the contour of cam *C*. In the position shown in Fig. 5, roller *G* still rests on the "drop" side of the cam lobe. The action of spring *J* serves to hold roller *G* in contact with cam *C*, causing slide *A* to be drawn forward. This action, in turn, causes slide *B* to feed work *W* forward. The forward motion of slide *A* continues until both rollers *G* and *E* come in contact with the low portion of the lobe on cam *C*, as shown in Fig. 1. Until the lobe of cam *C* again comes in contact with roller *E*, work *W* is held firmly in position. With this mechanism, work *W* is given a rapid, short, intermittent feed with a long rest period between movements.

* * *

We need a refresher course on the fundamental principles on which our country was founded and a renewed faith in our American democracy as a living, vital system of working and living together—the best that has ever been evolved in this troublesome world—*C. E. Wilson, President, General Motors Corporation*

Reducing Vibration in a Lathe by Relocating Motor and Countershaft

By WILLIAM HENRY MORRISON

The motor and countershaft of a lathe located directly over the machine caused a great deal of vibration in the lathe. By changing their location and mounting them on an angle-iron frame fastened to the floor at the rear of the lathe, this vibration was eliminated. A foot-pedal within easy reach of the operator was provided for releasing the belt.

* * *

Three-Dimensional Plant Lay-Outs

The location of machine tools, conveyors, heat-treating furnaces, and other equipment in a mass production plant requires very careful thought and planning. At a recent conference with trade journal editors, Westinghouse engineers explained in detail the method of making such a plant lay-out. A model three-dimensional lay-out was shown that had been made in planning a munitions plant. In this lay-out, all the machines, furnaces, etc., were represented by small wooden models, permitting a minute study of every movement of the product to be made, from the first operation to the last. It was stated that while lay-outs requiring the making of models of each machine are expensive, the cost is insignificant in comparison with the total cost of equipping a plant, and many expensive mistakes in plant arrangement are avoided by such a three-dimensional lay-out, which gives everyone a chance to study the plant arrangement.

New Trade Literature

RECENT PUBLICATIONS ON MACHINE SHOP EQUIPMENT, UNIT PARTS, AND MATERIALS

To Obtain Copies, Fill in on Form at Bottom of This Page the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the September, 1945, Number of MACHINERY

Coated Abrasives

CARBORUNDUM CO., Niagara Falls, N. Y. 84-page book entitled "Sanding and Finishing," containing information about coated abrasives, including an explanation of the new system for identifying coated abrasives. A copy can be obtained by users of these products if request is made on a company letterhead.

Handbook on Machining Stainless Steels

RUSTLESS IRON AND STEEL CORPORATION, Baltimore 13, Md. Handbook containing detailed data designed to aid in the selection of the machines, type of tools, cutting rates, feeds, and coolants that will provide maximum production and tool life in machining stainless steel. Information on composition and properties is included. 1

Aluminum-Bronze Products

AMPCO METAL, INC., 1745 S. 38th St., Milwaukee 4, Wis. Bulletin 64A, on extruded rounds and shapes, rolled sheets, hollow bars, and swaged rod. Bulletin 71, outlining the products and facilities of this company for producing Ampco metal and Ampcoloy bronzes, and containing suggestions for post-war use. 2

Roll Thread Snap Gages

PRATT & WHITNEY DIVISION NILES-BEMENT-POND CO., West Hartford 1, Conn. Circular entitled "Times Have Changed," announcing the new revolutionary P & W roll thread snap gage with pressure control on both "Go" and "Not Go" rolls. 3

Handbook on Stainless-Steel Sheets

EASTERN STAINLESS STEEL CORPORATION, Baltimore 3, Md. Handbook containing data on the composition, properties, and applications of stainless steel, as well as information on sizes of plates, weights, finishes, and processing and fabrication. 4

Haynes Stellite Tools

HAYNES STELLITE CO., unit of UNION CARBIDE AND CARBON CORPORATION, Kokomo, Ind. Catalogue describing the high-production metal-cutting tools made from Haynes Stellite 98M2 and Star J-Metal alloys. 5

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listed on pages 195-197 (without charge or obligation), fill in below the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail within three months of the date of this issue to:

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Gas Cutting and Welding

AIR REDUCTION SALES CO., 60 E. 42nd St., New York 17, N. Y. Booklet ADG-2014, entitled "Oxygen—an Indispensable Servant of Industry," describing welding, flame-hardening, gas cutting, underwater cutting, and other flame processes. 6

Metal Disintegrator

CLINTON MACHINE CO., Clinton, Mich. Booklet entitled "Metal Disintegration by the Thomas Process," explaining a process that utilizes electricity for disintegrating ferrous metals for such purposes as removing broken taps and cutting hardened steel. 7

Heat-Treating and Brazing Furnaces

LINDBERG ENGINEERING CO., 2450 W. Hubbard St., Chicago 12, Ill. Bulletins 160 and 170, on Lindberg Cyclone gas-fired tool-room and production type furnaces, respectively. Bulletin 201, on Lindberg all-purpose brazing furnace. 8

Eutectic Low-Temperature Welding

EUTECTIC WELDING ALLOYS CO., 40 Worth St., New York 13, N. Y. Bulletin EW-20, entitled "Production Ideas," discussing the application of eutectic low-temperature welding alloys in various production fields. 9

Machine-Shop and Sheet-Metal Service

HUDSON AMERICAN CORPORATION, 25 W. 43rd St., New York 18, N. Y. Three illustrated service bulletins describing the company's facilities for machine shop service, sheet-metal service, and electroplating service. 10

Multi-Purpose Grinder Attachment

STRONG MFG. CO., 5312 Westminster Ave., Philadelphia 31, Pa. Circular No. 45-C, descriptive of a multi-purpose attachment designed to extend the range of surface grinders for precision operations. 11

Special Multiple-Spindle Drilling Machines

NATIONAL AUTOMATIC TOOL CO., INC., 710 S. N St., Richmond, Ind. Catalogue describing typical operations performed on Natco Holeway machines, illustrated diagrammatically, as well as pictorially. 12

Roll-Formed and Resistance-Welded Steel Rings

FEDERAL MACHINE & WELDER CO., 208 Dana St., Warren, Ohio. Booklet describing a complete plant for the manufacture of roll-formed and resistance-welded steel rings, as designed and built by the Federal organization. 13

Idler Back-Stands for Grinding and Finishing

BEHR-MANNING CORPORATION, Troy, N. Y. Booklet containing engineering and production data on the speeding up of grinding and finishing operations with idler back-stands. 14

Permanent-Mold Aluminum Castings

PERMOLD CO., Medina, Ohio. Bulletin 45 PMC, containing information for designing engineers, production executives, and metallurgists on permanent-mold aluminum castings. 15

Multiple Boring and Drilling Machines

B. M. ROOT CO., York, Pa. Bulletin 131, on Root hydraulic-feed multiple borer, a machine having a wide application for drilling metals, composition materials, wood, and plastics. 16

Replaceable-Face Hammers

GREENE, TWEED & CO., Bronx Blvd. at 238th St., New York 66, N. Y. Folder explaining the features of the Basa replaceable-face hammer, designed for use on surfaces that must be protected from marring. 17

Shop Equipment

PRECISION EQUIPMENT CO., 32 N. State St., Chicago 2, Ill. Indus-

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 211-240 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in September, 1945, MACHINERY.

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trial Buyer's Bulletin, listing shop equipment that is ordinarily difficult to obtain, but that this firm has in stock for immediate delivery. ____ 18

Steel Plate Shapes

BY-PRODUCTS STEEL CORPORATION, DIVISION OF LUKENS STEEL CO., 181 Strode Ave., Coatesville, Pa. Circular 270, on flame-cut, sheared, pressed, bent, blanked, and welded steel plate shapes.____19

Steam Platens

LUKENS STEEL CO., 265 Lukens Bldg., Coatesville, Pa. Circular 265, descriptive of Lukens steam platens, designed to insure uniform surface temperature and rapid heat transfer. ____ 20

Compression Molding Presses

WATSON-STILLMAN CO., Roselle, N. J. Bulletin 640-A, illustrating and describing Watson-Stillman semi-automatic compression molding presses with capacities from 50 to 1200 tons. ____ 21

Electronics

ALLIS-CHALMERS MFG. CO., 568, Milwaukee 1, Wis. Book entitled "Introduction to Electronics," outlining the principles of electronics and the part they will play in future industrial developments. ____ 22

Milled Curved-Tooth Files

AMERICAN SWISS FILE & TOOL CO., 410 Trumbull St., Elizabeth 1, N. J. Circular on American Swiss milled curved-tooth files, listing types, sizes, and cuts now authorized by the W.P.B. ____ 23

Drill Chucks

K. O. LEE CO., Aberdeen, S. D. Catalogue containing an interchangeable chuck list, showing the correct size and model of "Knock-Out" drill chuck to use with various makes of portable tools.____24

Centrifugal Casting Machines

CENTRIFUGAL MACHINE & ENGINEERING CO., 633 Jackson Court, Kalamazoo 7, Mich. Bulletin on Centri-Meco centrifugal casting machines for ferrous and non-ferrous metal castings. ____ 25

Pneumatic Tools

MASTER TOOL CO., INC., 5605 Herman Ave., Cleveland 2, Ohio. Circular descriptive of two new pneumatic grinders—the "Master Power" vertical grinder and the "Master Power" die grinder. ____26

Airless Wheelabrator Tables

AMERICAN FOUNDRY EQUIPMENT CO., 555 S. Byrkit St., Mishawaka, Ind. Five catalogues on the company's line of airless Wheelabrator tables, of both multi-rotary and plain types. ____ 27

Precision-Machined Phosphor-Bronze Bars

SHOOK BRONZE CORPORATION, Greenlawn and Lake Sts., Lima, Ohio. Folder listing over 400 stock sizes of precision-machined, close-grained, phosphor-bronze bars.____28

Tool Steel

CRUCIBLE STEEL COMPANY OF AMERICA, 405 Lexington Ave., New York 17, N. Y. Data Sheet on Airdi 150 high-carbon high-chromium tool steel. ____ 29

Standards for Precision-Ground Taper Pins

CENTERLESS GRINDING CO., 19 Staples St., Bridgeport 1, Conn. Data book giving standards for precision-ground taper pins. ____30

Synthetic Rubbers

HYCAR CHEMICAL CO., 335 S. Main St., Akron 8, Ohio. Catalogue entitled "Everywhere in Industry," describing special-purpose synthetic rubbers for industrial use. ____31

Arc Welding

GENERAL ELECTRIC CO., Schenectady 5, N. Y. Bulletin GEA-3329, entitled "How to Repair Tractor Parts by Arc Welding." ____32

Surface Finish Comparator

COMPAR-INSTRUMENT CO., 16179 Hamilton Ave., Detroit 3, Mich. Bulletin on the "Comparoscope"—an optical instrument for evaluating surface finishes. ____ 33

Gear Checking Machines

MICHIGAN TOOL CO., 7171 E. McNichols Road, Detroit 12, Mich. Technical bulletin No. 1130-45, on Model 1130 base pitch and tooth spacing checking machine. ____34

Inserted-Blade Cutting Tools

GAIRING TOOL CO., 21221 Hoover Road, Detroit 32, Mich. Condensed catalogue covering Gairing standard, special, and inserted-blade cutting tools. ____ 35

Magnifying Lens for Shop Use

GEORGE SCHERR CO., INC., 199 Lafayette St., New York 12, N. Y. Bulletin on the "Magni-Ray," a magnifying lens for toolmakers, inspectors, etc. ____ 36

High-Strength Steel

REPUBLIC STEEL CORPORATION, Cleveland 1, Ohio. Bulletin on three high-strength steels—"Aldecor," "Cor-Ten," and "Double Strength." ____ 37

Turret Heads for Drilling Machines

CHICAGO DRILLET CORPORATION, 919 S. Michigan Ave., Chicago 5, Ill. Bulletin on Quadrill—a four-position turret drill head. ____38

Magnetic Chucks

MAGNETIC HOLDING DEVICES, INC., 2034 E. 22nd St., Cleveland 15, Ohio. Bulletin on "Body Flo" magnetic lathe chucks. ____39

Measuring Blocks and Instruments

FORD MOTOR CO., JOHANSSON DIVISION, Dearborn, Mich. Catalogue 17, on Johansson gage-blocks and accessories. ____40

Heat-Treatment of Steel

SURFACE COMBUSTION CORPORATION, Toledo 1, Ohio. Bulletin SC-125, on skin recovery (carbon restoration) in Surface Combustion furnaces. ____ 41

Isothermal Treatment of Bearing Races

AJAX ELECTRIC CO., INC., Frankford Ave. at Delaware Ave., Philadelphia 23, Pa. Treatise entitled "Bearing Races Improved by Isothermal Treatment." ____42

Control Switches

MICRO SWITCH DIVISION OF FIRST INDUSTRIAL CORPORATION, Freeport, Ill. Circular describing the use of the Micro Switch in automatic plastic molding presses. ____43

Welding Positioners

STANDARD MACHINERY CO., Providence 7, R. I. Bulletin on welding positioners, completely powered. ____ 44

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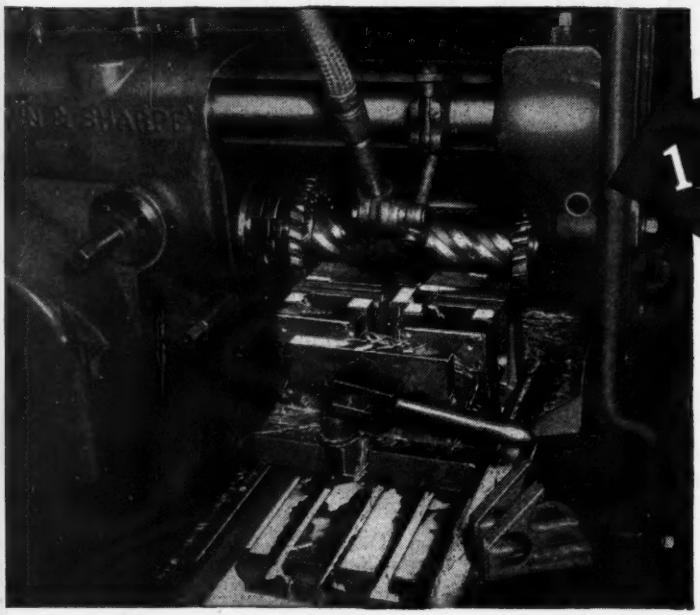
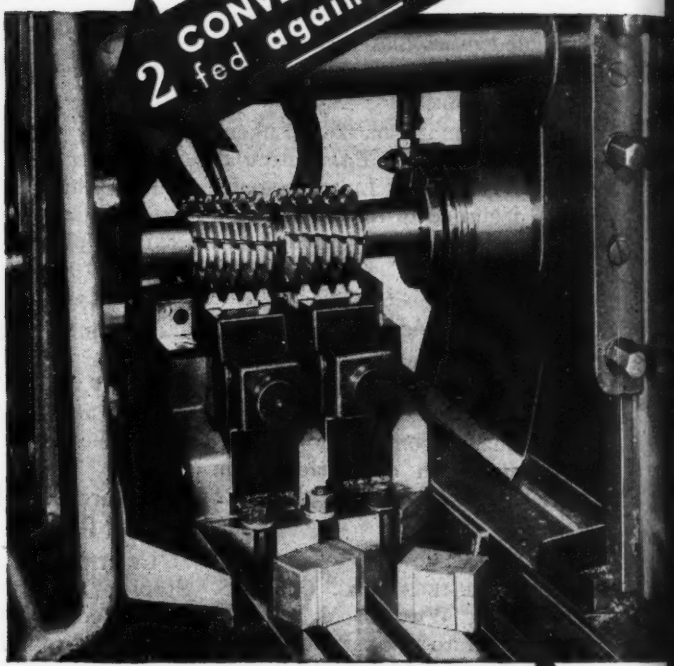
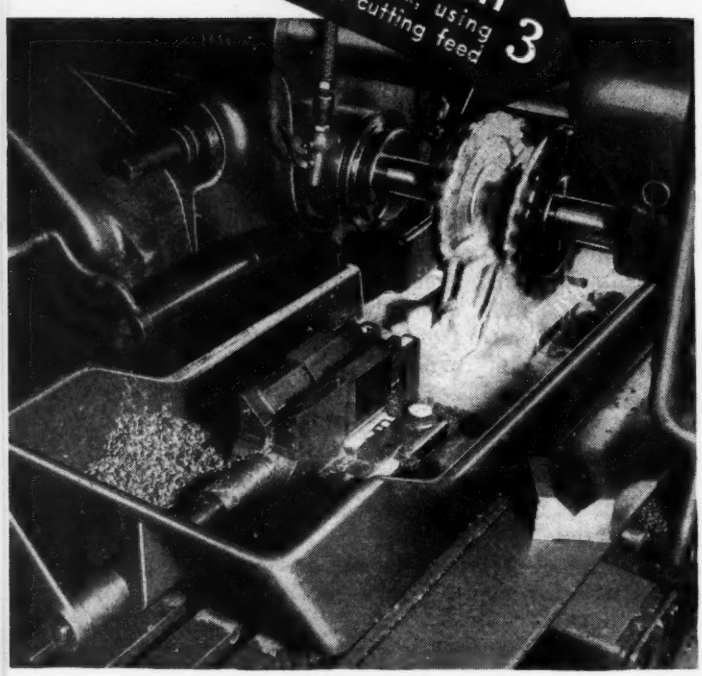


1 CLIMB—work fed with the cutter

2 CONVENTIONAL—work fed against the cutter



ROUGH AND FINISH 3
at one loading of work, using automatic reverse in cutting feed



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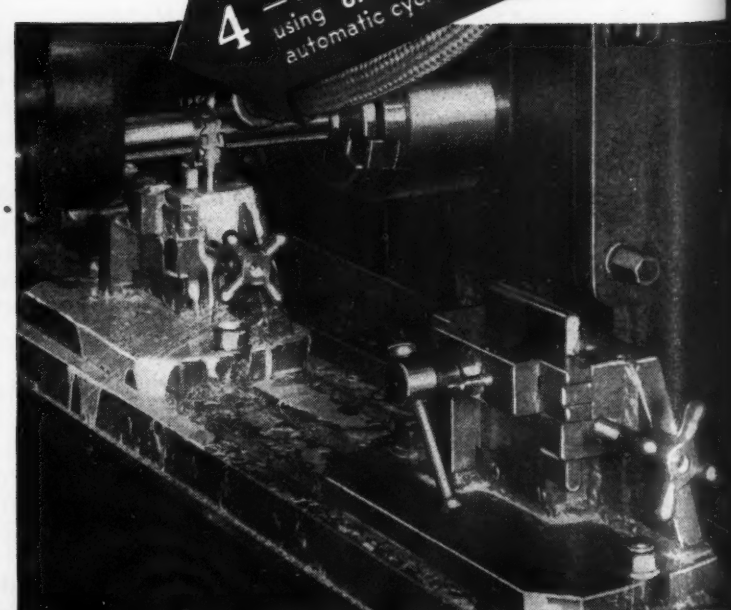

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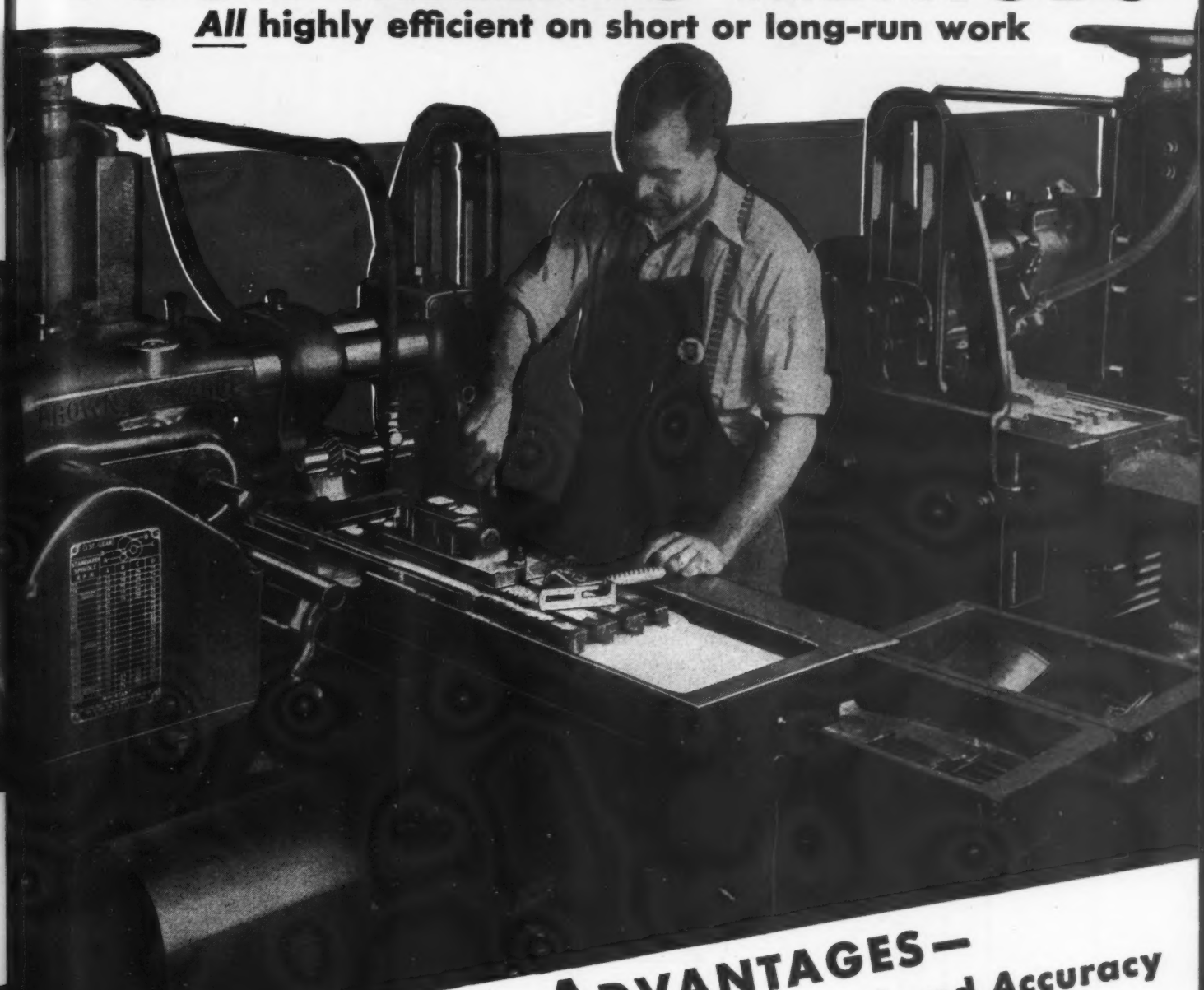

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  - Dual Feed Rates
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  - Accurate Table Stop and Reverse
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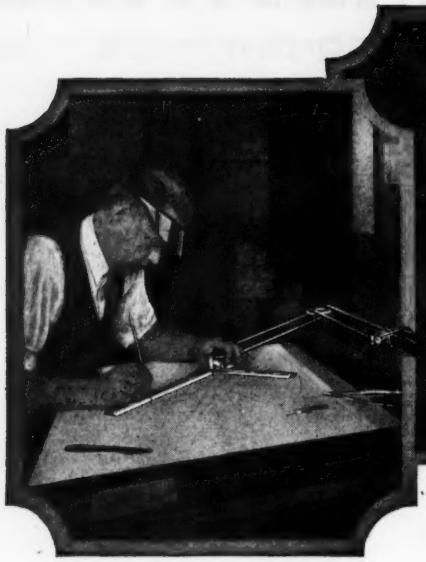
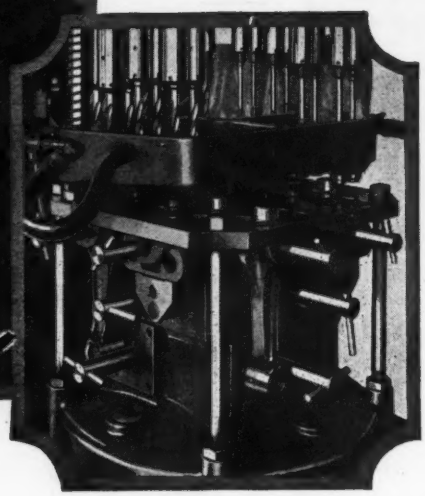
- **WIDE SPEED AND FEED RANGES**
  for a variety of materials and cutting tools

SHARPE



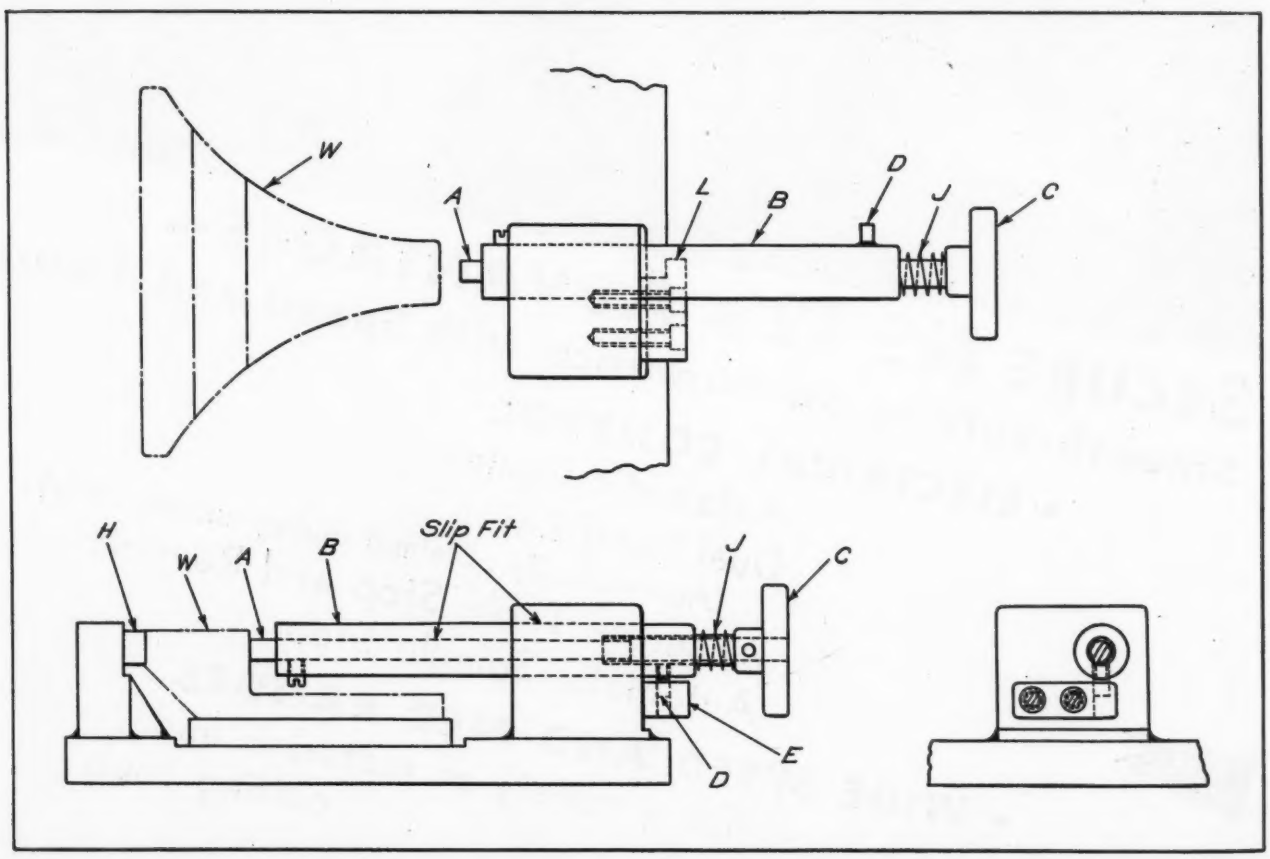
Design of Tools and Fixtures



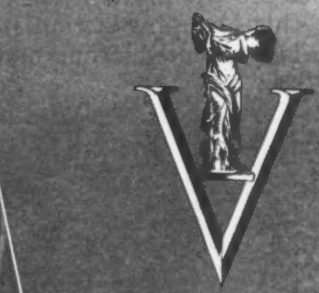
Fixture with Overhanging Quick-Acting Clamp

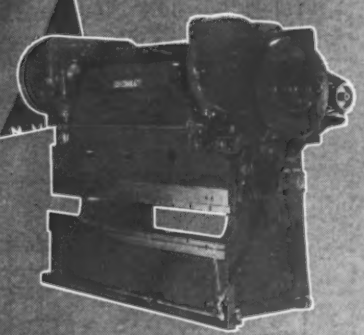
By M. W. BOSSMAN, Dayton, Ohio

The fixture shown in the accompanying illustration was designed with an overhanging quick-acting clamping screw *A* to meet the rather unusual requirements for holding the piece *W* indicated by dot-and-dash lines. The lower view shows the clamping screw *A* in the work-holding position, while the upper view shows the screw and its supporting plunger *B* withdrawn to permit removal of the work. After placing a new piece *W* in the fixture, it is securely clamped by simply gripping knob *C* and pushing it as far as it will go, then giving it a final turn to the right.

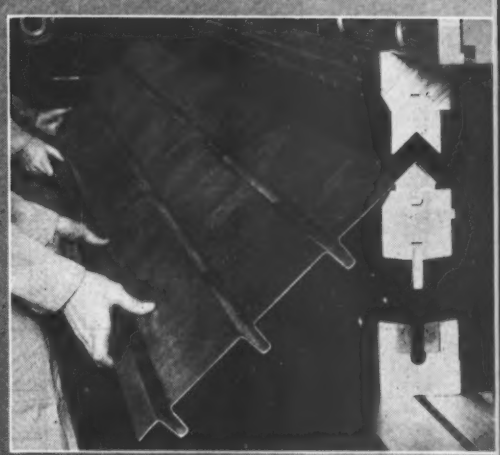


Quick-acting Clamp Designed to Hold Part W





A DOUBLE DECKER DOES THE WHOLE JOB...



Two completely different bends on one press brake, with one set-up and one handling, are being made on this Cincinnati Press Brake and Double Decker Die. No time is lost in changing dies or shifting work to a second machine.

This combination of smooth machine operation and correctly engineered dies is streamlining the job.

Write for Catalog B-2.

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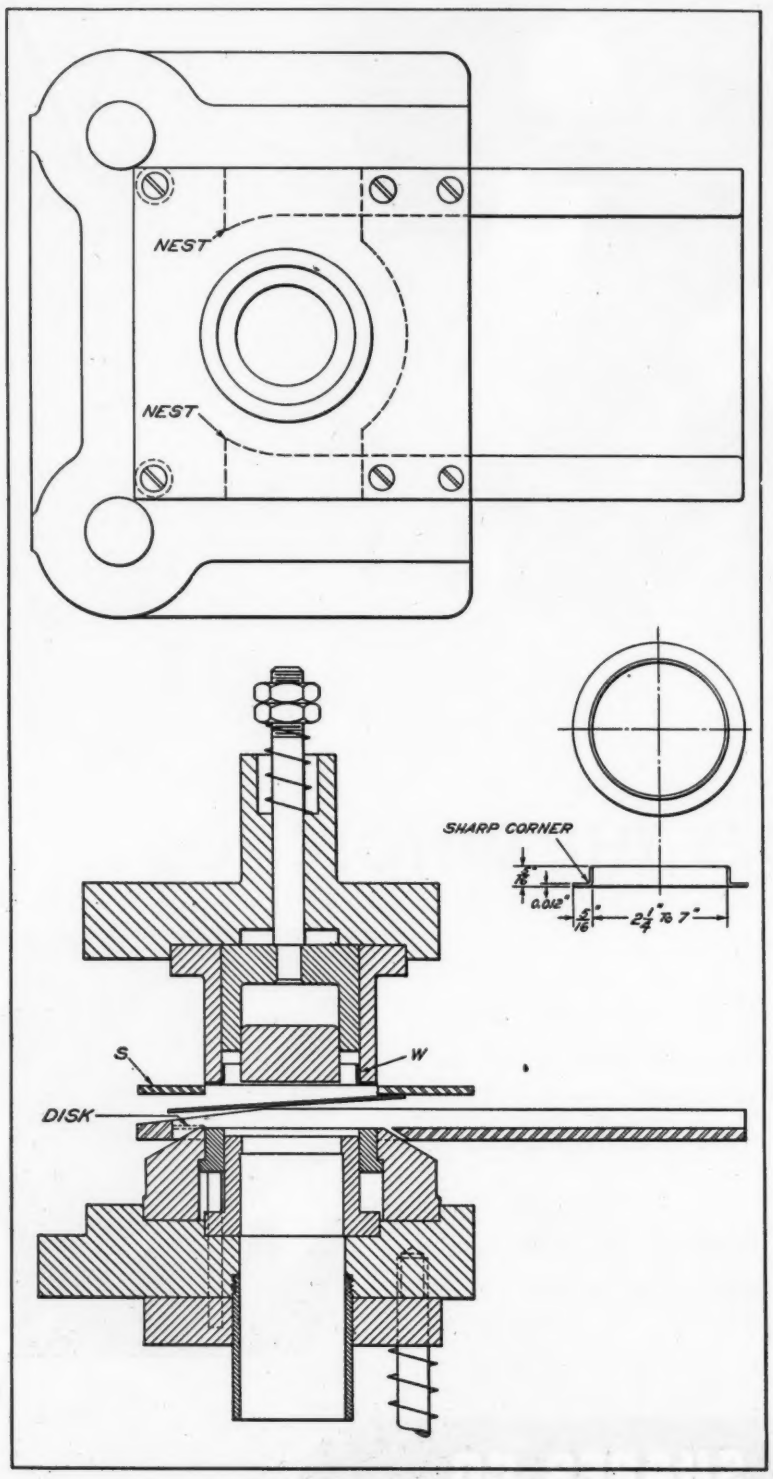
In the performance of this simple clamping movement, pin *D*, on striking stop-block *E*, prevents further rotation of plunger *B*, while continued rotation of knob *C* causes clamping screw *A* to turn in the threaded plunger *B* and force the work against stop *H*. The force of this clamping action is taken by pin *D*, which is prevented from moving outward or to the right by lug *L* on block *E*. The function of the spring *J* is to create sufficient friction between the threads on the clamping screw *A* and the plunger *B* to cause these two members to rotate as required for the engagement and disengagement of pin *D* in the slot in back of lug *L*. Pin *D* is screwed tightly into a tapped hole in plunger *B*, and is secured by welding or brazing when these members have been assembled.



Die Designed to Draw Vertical Flange Entirely from Stock around Edge of Inner Blanked Hole

Die Designed to Save Stock by Drawing Metal from Around Inner Blanked Hole

By WALLACE C. MILLS, Rockford, Ill.

The die here illustrated was designed for the production of sheet-metal rings of the type shown at *W* and by the enlarged view to the right. These rings are used to cover and reinforce the open ends of pasteboard tubes contained in ammunition cases. They vary from 2 1/4 to 7 inches in diameter, and have flanges 5/16 inch high and 5/16 inch wide. The corner between the vertical and the horizontal flanges is sharp. This ring is produced with the sharp corner in one operation, and at considerable saving in stock, by drawing the material from the metal surrounding the hole blanked in the center of the work.

This ring might have been made by drawing a hat-shaped shell in one operation and then punching the bottom out in a second operation; or it might have been made in a single operation by drawing the shell part way down, then center-blanking, and finally continuing the draw to the required ring depth. It was found, however, that all the stock in the vertical flange could be drawn from the inside after the center hole had been punched on all sizes of rings larger than 2 inches in diameter. It is only necessary to have a sharp corner on the punch instead of the usual drawing radius and to apply extra spring pressure.

The saving in stock amounts to 3.1 square inches, or 27 per cent, for a ring 2 1/2 inches in diameter over the method of drawing all

TOUGH STUFF

Photo: Courtesy Bethlehem Shipbuilding Co., Quincy, Mass.

Five-inch holes—in armor plate six and one-half inches thick, were completed in one drilling and two fly-cutting operations. From fifty to several hundred holes were produced per piece. The unusual performance of this Cincinnati Bickford Super Service Radial demonstrated its outstanding accuracy, ease of handling, and stamina.

Consult us on your drilling problems.

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See our condensed catalog in Sweet's File.

The Cincinnati Bickford chrome nickel spindle sleeve and bearings feed down with the spindle—so no matter what the length of feed, the spindle is rigidly supported. Feed pressure is taken by an unusually large thrust bearing. Roller and ball bearings require lubrication at intervals of three to four months.

Equal Efficiency of Every Unit Makes the Balanced Machine

RADIAL AND UPRIGHT SUPER SERVICE DRILLING MACHINES

THE CINCINNATI BICKFORD TOOL CO. Cincinnati 9, Ohio U.S.A.

the stock on the outside and then cutting out the bottom. For a ring 7 inches in diameter, it amounts to 8.7 square inches, or 13 per cent. For 5-inch diameter rings, the saving is 5.4 square inches, or 37 square feet per thousand parts, which is equivalent to 37,000 square feet per million pieces.

Further saving is accomplished by cutting smaller reinforcing rings from the disks punched out of the larger rings. The die is mounted in a press of the inclined type. The disks are fed into a chute, and come to rest in a nest under the punch. When the punch rises after cutting out the blank, the ring of scrap stock is stripped from it by the stripper *S*. The scrap falls to the rear of the nest and slides out of the die, as the press is operated in an inclined position. The work is carried to the stripper by the punch and is knocked out above the stripper and blown out of the die by compressed air.

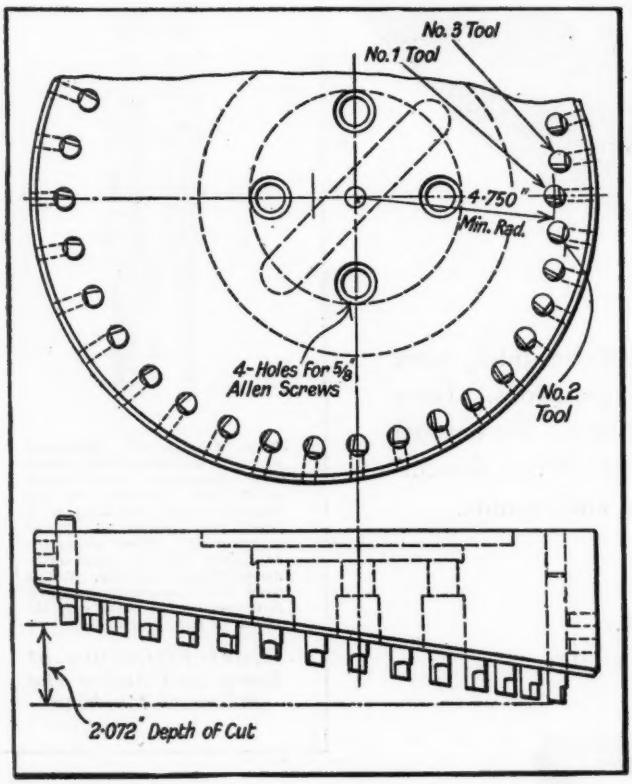
Eccentric Milling Cutter Designed to Lessen Cutting Stresses

Compressive stresses set up in light alloy sections by face milling operations are often sufficient to cause distortion of the work when it is released from the fixture. The special eccentric cutter shown in the illustration was designed to eliminate the possibility of undue stresses of this kind being set up in a light alloy cylinder-head casting when milling service lugs from its top face. The service lugs in this case were provided for locating purposes during preliminary machining operations, after which they were removed by milling.

The eccentric cutter, for which patents have been applied, has its arbor hole bored eccentrically to give a minimum milling radius of 4.75 inches, as indicated in the illustration. Lack of balance, which might be caused by the eccentric movement of the cutter, is offset by having the upper and lower faces of the cutter-block angularly positioned with respect to each other.

The cutter has thirty-six teeth, set at varying heights around the cutter-block, which has a diameter of 14 inches. Each cutter follows a separate path on the work, and as the various paths are at different depths, the cutter machines a series of steps on the work as it advances.

The lugs are removed in one cut, using a spindle speed of 1000 R.P.M. and a feed of 10 inches per minute. The maximum depth of metal removed is 2 inches. Only one cut is taken, no extra finishing cuts being necessary, as the final finish is given the work by the tool marked No. 1 in the illustration.



Milling Cutter with Eccentrically Positioned Inserted Cutters Used to Remove Lugs from Cylinder-head Castings

* * *

Incentive Wage Plans

A survey of incentive wage plans now in use has been published by the Douglas T. Sterling Co., Gurley Bldg., Stamford, Conn., management consultants. Questionnaires mailed to a nation-wide list of 2400 industrial organizations were answered by 306 users of incentive wage plans. From their answers a 24-page booklet, 8 1/2 by 11 inches, has been prepared which gives first, a summary of the survey; second, eleven pages of direct quotations; and then, a list of the industries represented in the survey. Copies of this booklet are available free from the Douglas T. Sterling Co.

* * *

Fifty-three new types of synthetic rubbers were produced in the three synthetic rubber plants operated by the United States Rubber Co. in 1944. Of these, eight have been adopted for regular use in the manufacture of rubber insulation of electric wire and cable, and for porous rubber storage battery separators, asbestos sheet packing, and pressure sensitive adhesives; during the year 14,000,000 pounds were made for these special purposes. New uses are constantly being found for many of the other forty-five types.

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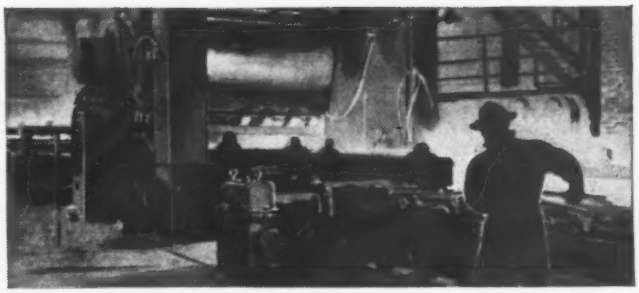
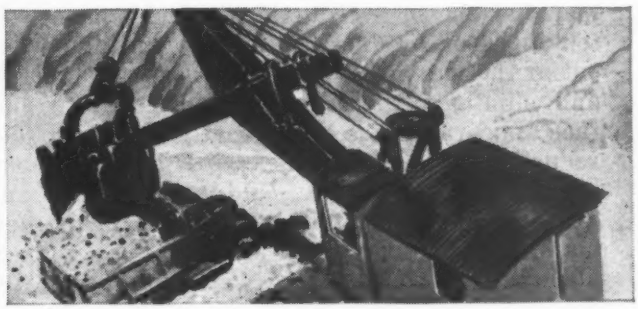
AIRCRAFT QUALITY GEARS. The close tolerances to which Foote Bros. Aircraft Quality gears are held—the extreme care with which each step in their production is checked and re-checked—the improved methods of heat treatment—all mean more compact gears that can carry heavier loads at higher speeds.



SPEED REDUCERS. When it comes to speed reducers for any one of a thousand different jobs, you naturally think of Foote Bros. Today—as for the past 86 years—Foote Bros. are producing quality speed reducers in a wide variety of sizes, types and ratios to meet every industrial need.



POWER UNITS. Compact power units are a new development of Foote Bros. engineers. Originally designed for airplanes, many manufacturers in varied fields are considering the application of these units to their machines. They may simplify a problem for you.

• The 89 years of manufacturing experience back of Foote Bros.—the large plant capacity devoted solely to producing power transmission equipment—the staff of skilled engineers whose background includes the solving of almost every type of problem in the field of power transmission—are your assurance that this organization can help you on the machines or equipment you are producing today or planning to produce for the future. Let our Engineering Division work with you on your requirements in power control equipment.

COMMERCIAL GEARS. This company has won the reputation for producing quality gears of every type and size in all materials. Complete facilities make it possible to manufacture gears on a production basis or to handle individual orders for special gears.

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This Bulletin giving complete information on "A-Q" gears will be sent on request.

Materials of Industry

THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Polystyrene Plastic with Greatly Improved Qualities

A greatly improved polystyrene, known as Styron 411, is being manufactured by the Dow Chemical Co., Midland, Mich., to replace Styron K-27. Among the mechanical advantages claimed for Styron 411 are increased weld strength and better machinability. Buffing operations are more easily performed. In trimming, the new material shows a reduction in the tendency to tear back or produce a laminar condition when cut at the gate. By improving the mold release and eliminating external lubrication, the surface appearance has been greatly improved. The reduction of surface marks in Styron 411 enhances the appearance, adding brilliance and gloss. Welds are scarcely perceptible in the new material and prove distinctly superior to regular polymers. 201

Eatonite Makes Possible Better Valves for Post-War Engines

A valve facing material that has been run in tests 200,000 miles without refacing is a development of the Wilcox-Rich Division of the Eaton Mfg. Co., Detroit, Mich. The new alloy, called "Eatonite," contains nickel, chromium, cobalt, and tungsten in proportions that retain the necessary hardness at extremely high temperatures, and at the same time resist the chemical action of compounds released during combustion by high-performance anti-knock fuels. Under exhaustive tests, Eatonite was found to retain essential hardness in the "red zone," above 1000 degrees F. Valves operate at the highest temperatures of any part of an engine—as high as 1500 degrees F.—and are exposed to the chemical action of anti-knock compounds in high-performance fuels.

The first application of the new alloy is expected to be in airplane, truck, tractor, and bus engines, where performance and maintenance are as important as first cost. In passenger car automobiles, at least 100,000 miles of service without refacing might be expected from Eatonite, compared to the ordinary limit of about 30,000 miles using standard automobile exhaust valve steel. Eatonite is applied to the valve face by a welding process, which bonds the alloy in a groove cut in the valve head. 202

Thermosetting Resins Developed for Impression Molding

During the last three years, rapid strides have been made in the development of resins for impression moldings. This promising new process involves the impregnation of a fabric or paper with a liquid plastic, followed by the draping of layers of the filler over or into a mold or form. A light, hard, rigid, durable product is then produced by baking the composite under very low or no pressure at temperatures about that of boiling water. This basically new fabricating method has been made possible by the development of completely reactive thermosetting resins, such as the "Thalid X500" series, by the Monsanto Chemical Co., Plastics Division, Springfield 2, Mass.

Conventional plastic molding methods demand high pressures which require machined steel dies and heavy press equipment. This limitation has confined the use of molded plastics to relatively small parts. Because the new moldings are fabricated under very low pressure, or with mere contact pressure, molds and the accompanying equipment can be produced cheaply and quickly from such materials as wood, sheet metal, plaster, or concrete. No hydraulic or mechanical presses are needed, and the limitation on size is thus removed. By the new process, parts as large as one-half of a monocoque of an aircraft fuselage have been produced in one piece without excessive investment in molds. The new process, therefore, opens entirely new fields for the application of plastic materials.

It is possible, for instance, to wrap layers of impregnated Fiberglas or other cloth or paper around a mold and produce a finished part by merely baking the whole assembly at low temperatures (about 220 degrees F.) for short periods. The composition of the resin can be adjusted to provide very rapid cures—as low as eight minutes after the center of the laminate reaches the curing temperature, even on large parts. The reaction, converting the liquid resin

To obtain additional information on materials described on this page, see lower part of page 196.

to a hard infusible, insoluble solid which binds the layers of filler together, produces sufficient heat to complete the final cure. No solvent or water is thrown off.

Fabricating methods now in use have been worked out specifically for war applications, but the inherent characteristics of the resins used suggest entirely novel processes, which have not yet been evaluated. Wall building panels, for instance, of large size could be produced by a continuous impregnating and curing operation. Other cheap, mass production methods will be utilized in particular fields of civilian use when such development is made possible by the availability of the resins. 203

Lubricant Improves Action of Metal-Cutting Saw Blades

A lubricant for band-saw teeth, prepared in stick form, has been developed by the Kindt-Collins Co., 12651 Elmwood Ave., Cleveland 11, Ohio. This lubricant is applied by pushing the stick against the teeth of the saw blade while it is in motion. When used on a metal-cutting saw, it tends to make cutting easier and faster and to increase the life of the saw blade. It also acts to keep chips from clogging the teeth, thereby preventing tooth breakage. 204

New Plastic Resins Provide High-Strength Materials

A new family of liquid plastics has been developed by the United States Rubber Co., Rockefeller Center, New York City. These materials, known as "Vibron" resins, when combined with spun glass or other fabrics, are said to have a strength per pound equivalent to that of steel.

Stronger building materials for prefabricated housing will be one possibility provided by the use of these plastics. They will also permit of reduced fabrication costs of numerous products, as they do not require expensive, high-pressure equipment for their manufacture.

Characteristic differences in physical properties, such as hardness, flexibility, and abrasion resistance in finished products, can be obtained by using different types of these resins. The Vibrons were produced for war purposes by the Chemical Division of the company at Naugatuck, Conn. 205

Compound Makes Foundry Molds Fire-Resistant

A new fire-resistant chemical for treating foundry molds has been announced by the General Detroit Corporation, 2270 E. Jefferson Ave., Detroit 7, Mich. This compound, called "Fi-Retard Liquid," reduces the danger of fire in foundry molds by making the wood fire-resistant. "Fi-Retard Liquid" is applied by simply dipping the molds in the liquid. The chemical solution is absorbed by the wood, and does not change the mold dimensions.....206

"Tri-San" – A New Material for Industrial Hygiene Uses

A sanitation material designed for industrial use, which deodorizes, cleans, and disinfects surfaces in one operation has been developed by Oakite Products, Inc., 22 Thames St., New York 6, N. Y. This product is a mild, alkaline, free-flowing powder, completely soluble in water, forming a clear, colorless, odorless solution. In dilutions recommended for various sanitizing tasks, it is practically non-toxic. Tri-San is suitable for use in washrooms, locker rooms, first-aid rooms, cafeterias, etc. 207

The Piece of Self-Lubricating Oilite Bronze Bar Stock Here Illustrated, which is Made from Powdered Metal, Weighs 228.7 Pounds. This is Believed to be the World's Record for the Size of a Powdered-metal Part. This Piece of Oilite Bronze is a Product of the Chrysler Corporation's Amplex Division

To obtain additional information on materials described on this page, see lower part of page 196.

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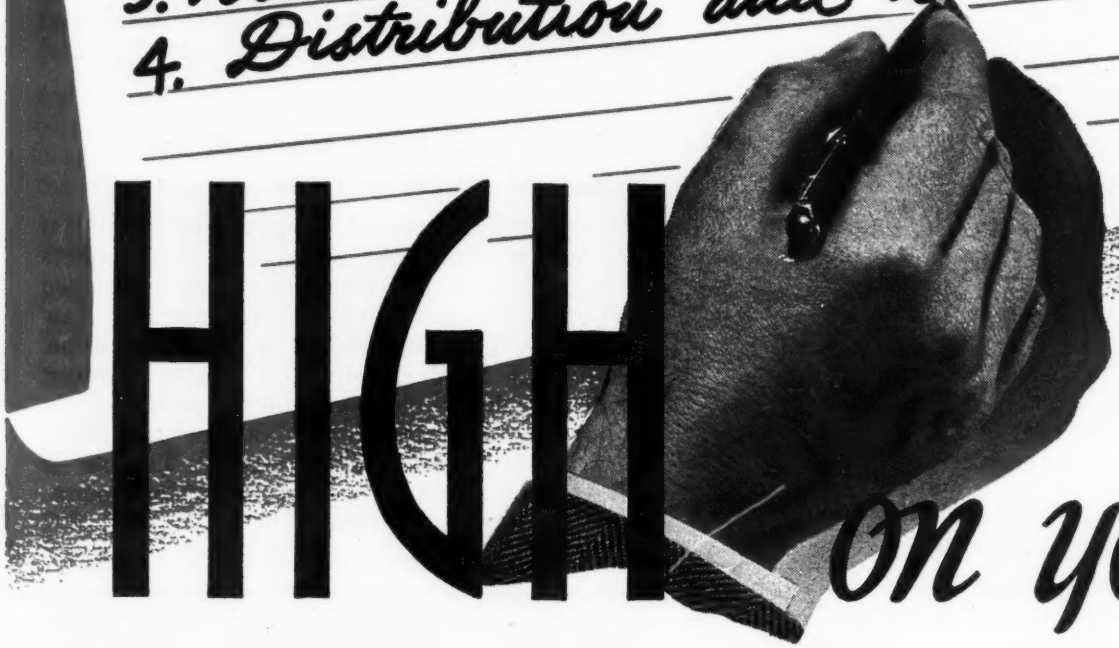

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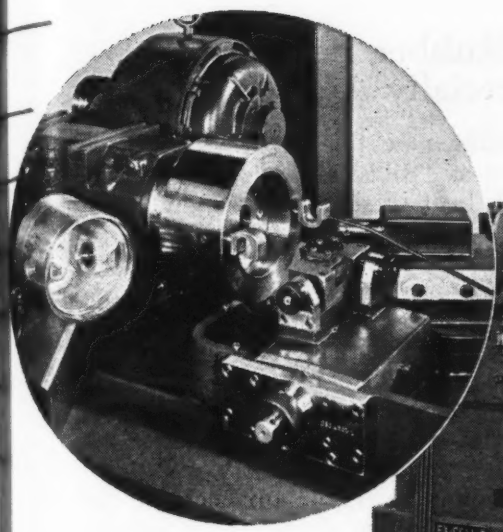
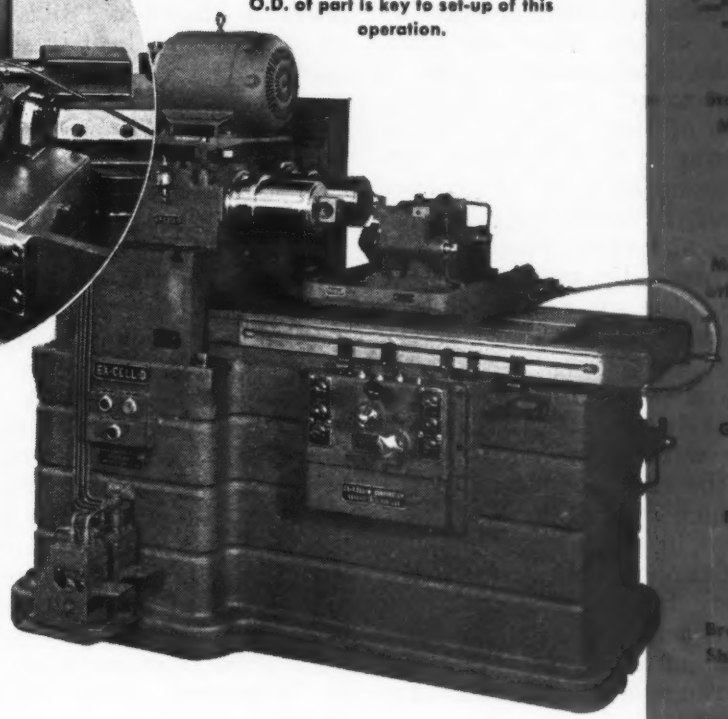


Below: Form turning O.D. of piston is operation here on an Ex-Cell-O Precision Boring Machine (Style 112-C). Master cam conforming to O.D. of part is key to set-up of this operation.



Above: Finish bore, facing, and chamfer operations are performed on piston by locating part on O.D. of dome; loading bar is inserted through wrist pin holes long enough to enable hydraulic clamps to take hold and pull piston against dome face. Fixture moves in, bores two diameters, and faces, in open end of skirt; angular slide then moves back and generates chamfer. Machine is Ex-Cell-O Style 2112-A Precision Boring.

reconversion list

Already is indicated the nature of things to come, as far as tomorrow's production costs are concerned. One main source for lower costs will be machine tools that offer more efficient methods for production, through progressive stations and multiple operations. In developing standard and special machine tools that perform a variety of close-limit operations, Ex-Cell-O has had unique experience that eminently qualifies it to meet the production problems facing the major industries of this country. Write to Ex-Cell-O Corporation, Detroit 6, Michigan, today.

Where increased production, high accuracy, and greater economy through multiple operations are required . . . See Ex-Cell-O First!

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Drill Jig Bushings

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•

Pure-Pak Paper Milk Bottle Machines

•

Aircraft and Miscellaneous Production Parts

DETROIT 6, MICH.

"Merry-Go-Round" Speeds Production of Tanks

The manufacture of high-pressure tanks needed by the thousands has been speeded up at the Dunkirk plant of the American Locomotive Co. through the development of what is known as a "merry-go-round" device. In planning the manufacture of these tanks, a major problem arose pertaining to their handling during a series of processing steps in which they were dipped successively in an acid, a neutralizing agent, and water, and then dried prior to painting. Herman Franck, the manager of the plant, conceived the idea of constructing a "merry-go-round" to handle this phase of the production.

Four vats are placed in a circle. The first three contain, respectively, the acid, the neutralizing agent, and the water; the fourth is the drying unit. Above the vats is constructed the "merry-go-round," which is equipped with four chain hoists, as shown in the illustration. On each hoist a cluster of three tanks can be placed; the tanks weigh empty 140 pounds. The tank clusters are dipped in each vat for ten minutes. Through the medium of the hoists and the "merry-go-round" arrangement, the tanks are moved from vat to vat.

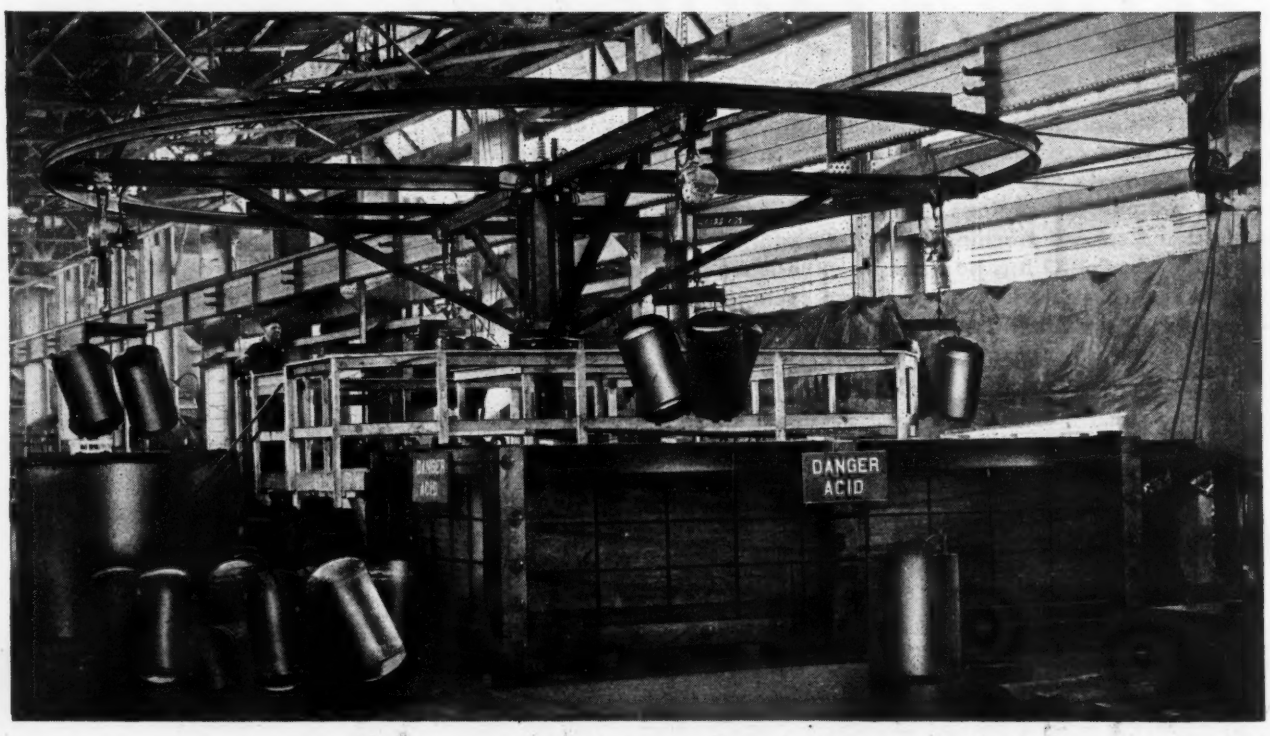
With this arrangement, each cluster completes the circuit in about forty minutes. In all, 18 tanks can be treated each hour, or 360 tanks daily in 20 hours. Only one operator is needed.

Silicone Rubber Becomes Commercially Available

A revolutionary new line of elastic silicone products known as "Silastic" and characterized by exceptional heat resistance is now being made commercially available by the Dow Corning Corporation, Midland, Mich. Silastic remains elastic at temperatures up to 500 degrees F. and retains flexibility at temperatures as low as 70 degrees F. It is built upon silicon-oxygen-silicon structures similar to those in mica, glass, and inorganic silicates, and owes its heat stability to its inorganic origin. Tensile strength is 200 to 330 pounds per square inch.

Silastic stocks are available for molding flat sheets, gaskets, and other shapes, and for continuous extrusion. Also available are stocks compounded for coating glass or asbestos cloth to produce flexible, waterproof, heat-stable, oil-resistant gaskets, diaphragms, tape, and electrical insulation which is non-tracking and arc- and oxidation-resistant. Laminates may be made by curing under pressure multiple layers of Silastic coated inorganic fabrics. Silastic is also used to insulate wire-wound resistors with waterproof, heat-resistant, elastic coatings able to withstand severe and repeated thermal shocks.

Silastic coatings adhere to glass, vitreous enamel, iron, steel, and aluminum. They constitute protective coatings which are resistant to oil and salt brines at elevated temperatures.



"Merry-go-round" Device Developed at the Dunkirk Plant of the American Locomotive Co. to Speed the Production of High-pressure Tanks

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Baker Multiple-Spindle Machines for Drilling and Reaming Rocket-Shell Plates

Baker Bros., Inc., Toledo 10, Ohio, have just built two new machines designed especially for the rapid, accurate drilling and taper-reaming of nozzle plates for 5-inch rocket shells. The machine shown in Fig. 1 is an adaptation of two Baker 3 1/2 by 24 hydraulic-feed, multi-spindle, floor type units combined to form a large size two-way drilling machine with a trunnion fixture located between the two units.

The nozzle plate for the rocket shell handled on this machine is 5 inches in diameter, and has eight tapered holes drilled on a 3 3/8-inch circle. Each hole has a diameter of 1 1/4 inches at the large end. All of these holes are radius-formed at one end, the radius-formed surfaces being concentric with the holes, which are required to have a good finish. All operations on each piece are performed on this multi-operation machine at one chucking in a sixteen-station special trunnion type fixture. The fixture is automatically indexed by power, and is provided with an ejector for removing parts at the loading station.

The special fixed-center head at the right-hand end of the machine has twenty-four spindles, and the one at the left-hand end has thirty-two spindles. The machine operates on a fully automatic cycle, the operator simply loading and unloading the parts while the operations of multiple drilling, taper-reaming, and radius forming eight holes from both sides in each part are being performed automatically.

The machine shown in Fig. 2 is a standard Baker 26 HO machine equipped with a special four-spindle fixed head and a fully automatic cycle fixture provided with four three-jaw chucks, each chuck being arranged for automatic indexing. The part handled on this machine is a nozzle plate approximately 5 inches in diameter by 1 1/4 inches thick. It has eight tapered holes that are evenly spaced on a circle and eight holes located at an angle on the circle.

The holes in the nozzle plate that are located at an angle cannot be multiple drilled with conventional methods except by a long, tedious

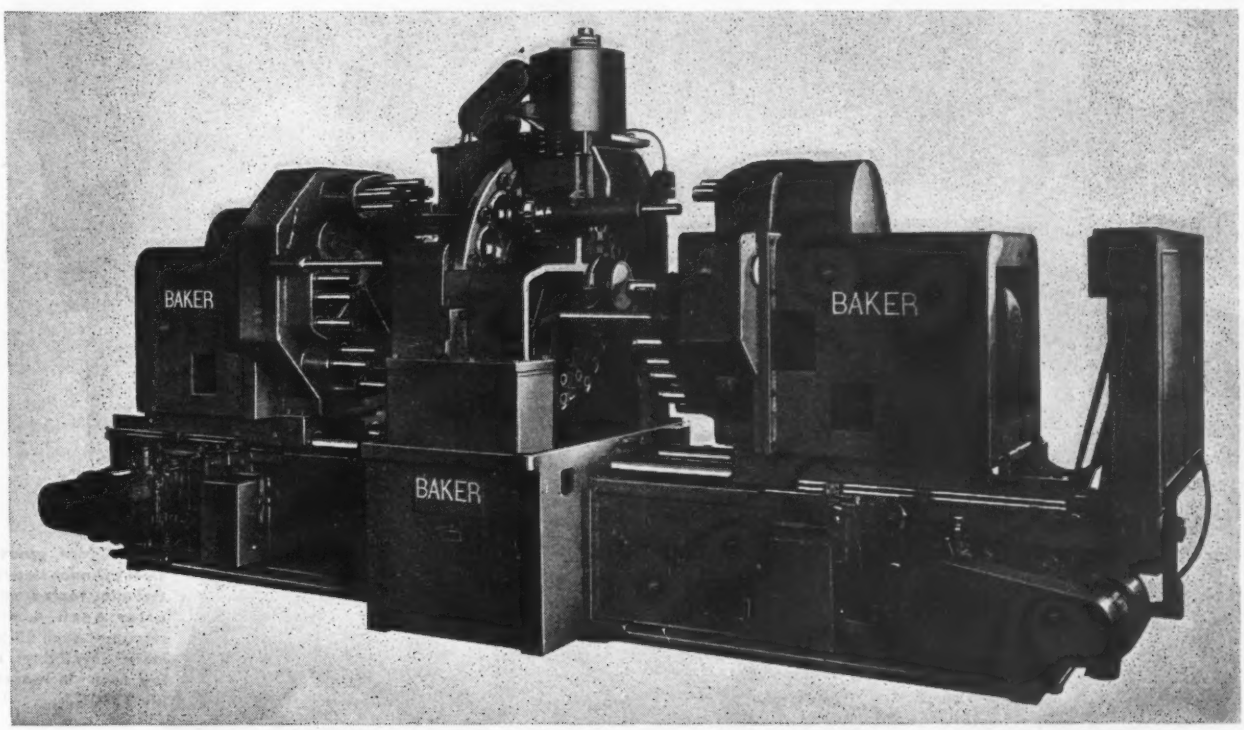


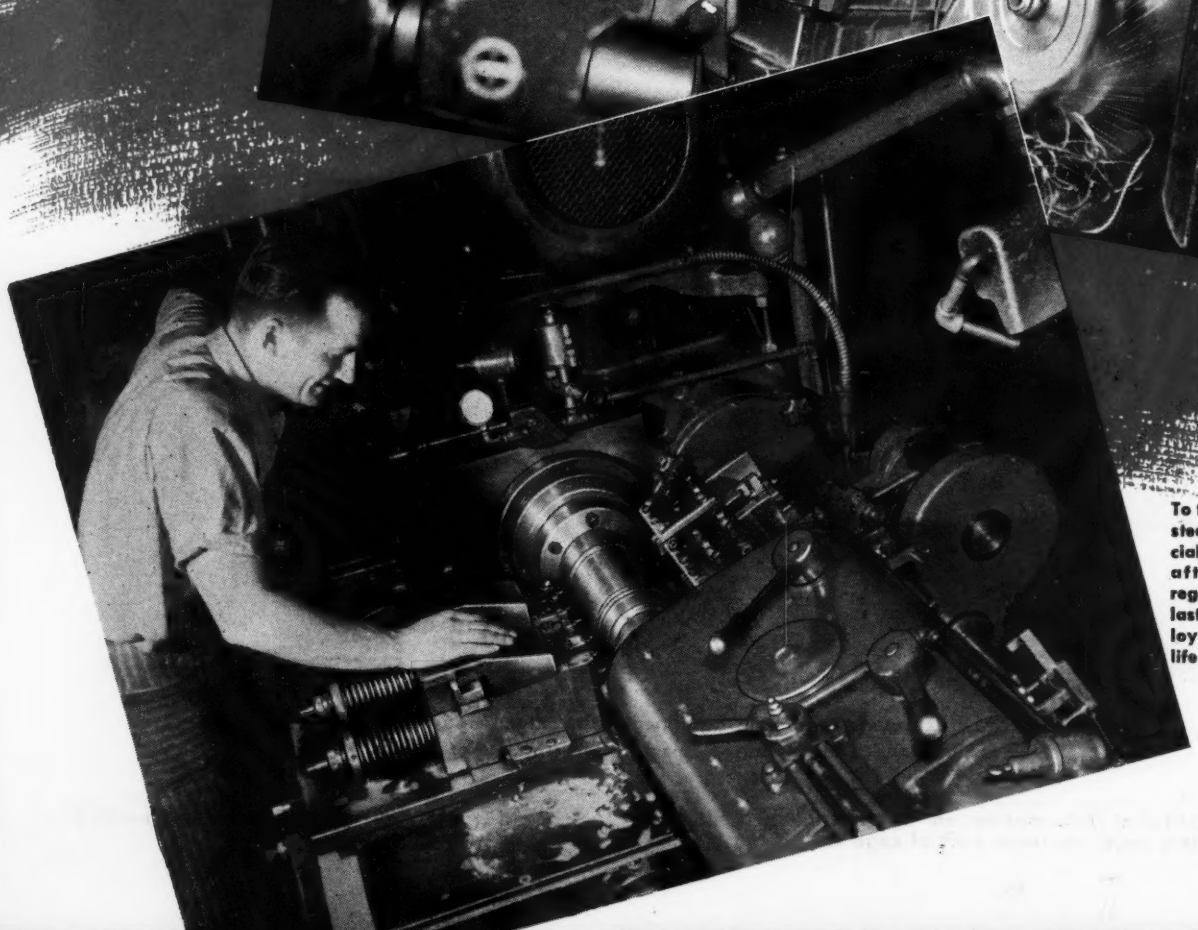
Fig. 1. Baker Multiple-spindle Two-way Machine Equipped with Sixteen-station Trunnion Type Fixture for Drilling and Taper-reaming Nozzle Plates for Rocket Shells

To obtain additional information on equipment described on this page, see lower part of page 196.

Keep Costs and

Parts [illegible] out twice as fast as before, with Carboloy [illegible] applied to turning, facing and form grooving this steel gear.

Standard Carboloy tools —Grade 78B—eliminate 19 tools and 75% of the hand finishing time previously required on this steel aircraft engine part.

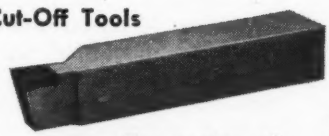


To turn, face, groove, this steel cylinder sleeve, special alloy tools were re-set after each 4 pieces; reground each 12 pieces; lasted only 2 days. Carboloy tools increased tool life 1500%.

DOWN... Quality Production UP!

with these CARBOLOY (TRADEMARK) CEMENTED CARBIDE Standards

Cut-Off Tools



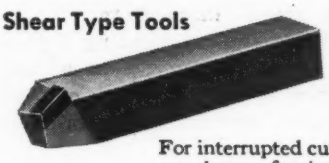
For cutting off to hollow cores such as shell forgings, etc.

Tools for Roller Turners ("Box" Tools)

Grooving Tools

Available in widths over .060" through .330" Tolerances up to .0004".

Shear Type Tools

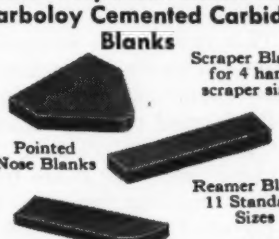


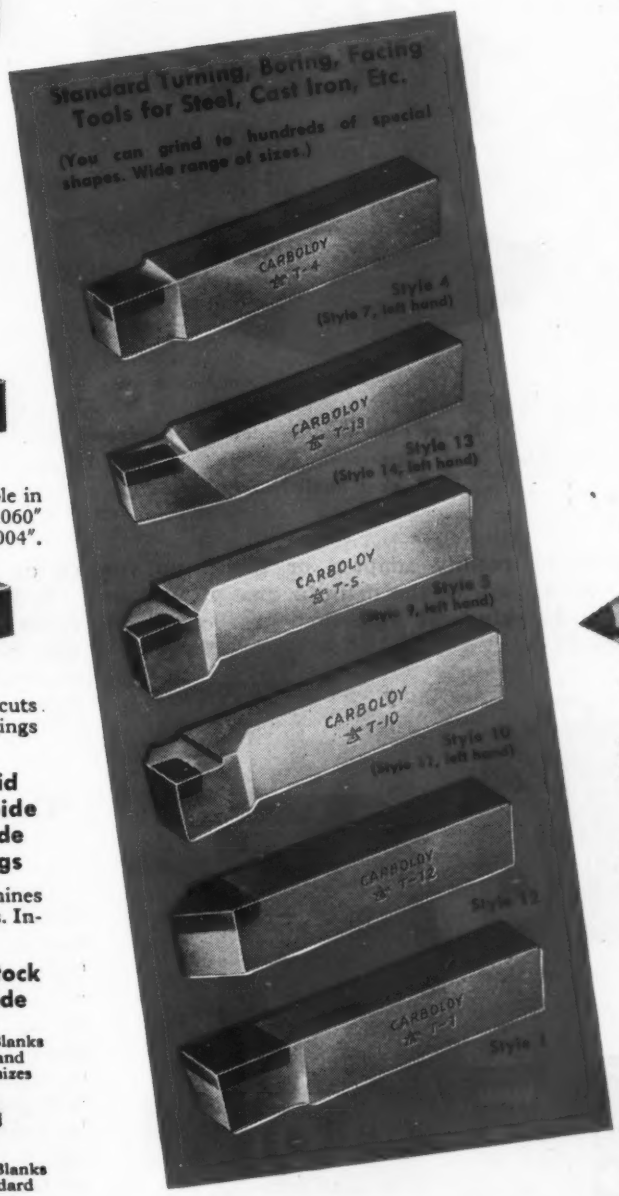
For interrupted cuts on large forgings and castings.

Solid Carbide Guide Rings

For wear resistant uses on machines such as wire stranding machines. Increases life up to 50 times.

Special-Purpose Standard Stock Carboloy Cemented Carbide Blanks





Masonry Drills

Drill concrete, brick, etc. 75% faster than old methods.

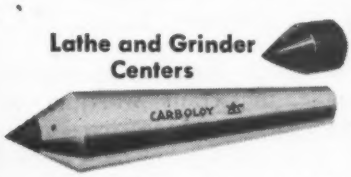
Diamond Impregnated Grinding Wheel Dressers

3 sizes. For all grinding wheels.

General-Purpose Standard Carboloy Blanks

Style 1000 Style 2000
Sizes 1/16" to 1/2" thick.

Lathe and Grinder Centers



(Up to 50 times longer life than steel.)
Carbide tips only.
Finished tipped centers (with Morse, B & S, and Jarno Tapers).

Precision Boring Tools

Precision "Boring" tools for high quality finish.
(You grind point to suit).

Send For Free Catalog

32-page catalog GT-175-R contains prices and specifications of all standard stock and standard design Carboloy Cemented Carbide tools. Write for your copy today.

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Also stocked and sold by Leading Mill Supply Distributors, coast to coast.

STANDARD CARBOLOY (TRADEMARK) TOOLS AND BLANKS

process. To provide for the high output required, a method was developed whereby the machine can be used for performing operations on four nozzle plates simultaneously. With this arrangement, four parts are chucked in the four three-jaw chucks, one under each spindle, to allow drilling one hole at a time.

It will be noted that the chucks are tilted to permit drilling the holes at the required angle. The holes are drilled from the solid with a special twist drill ground to the required taper. When this machine is in operation, a part is placed in each of the four chucks. The operating cycle is then started by simply pushing a button. The machine continues to function automatically until eight holes have been drilled in each part, the work-holding chucks indexing automatically. Proper functioning of the machine cycle is assured by an electrical interlocking system.

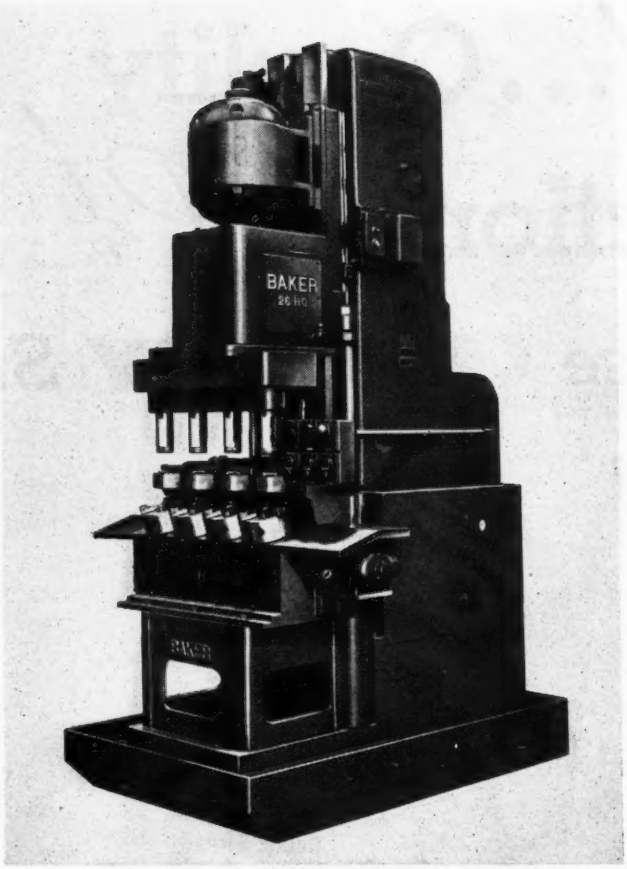


Fig. 2. Baker Four-spindle Machine Equipped for Drilling and Taper-reaming Eight Angular Holes in Rocket Shell Nozzle Plates

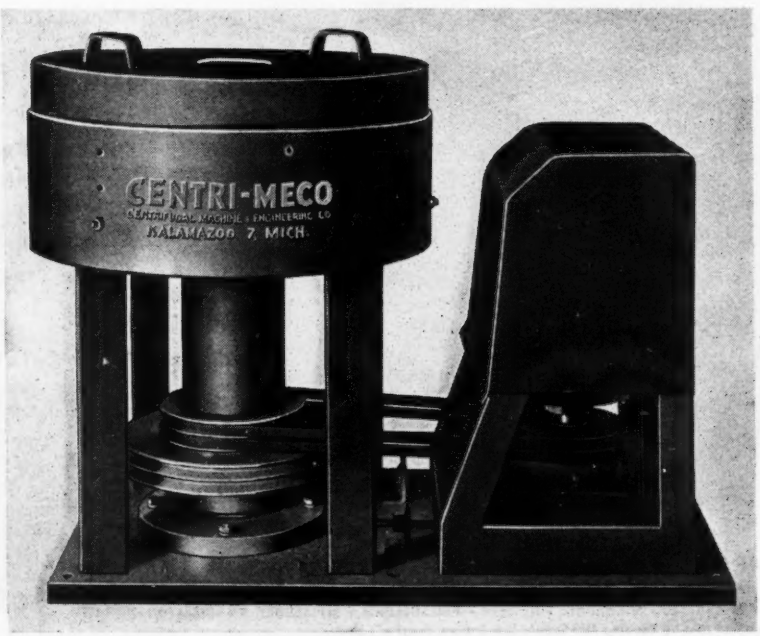
Although designed specifically to handle important wartime work, these two machines can also be readily adapted or tooled up for use in the manufacture of various kinds of peacetime products. 61

Mono-Ball Bearings and Spherical Bearing Rod Ends

To obtain extreme freedom of movement in certain aircraft bearing constructions, the Heim Co., Fairfield, Conn., has developed a spherical mono-ball bearing and a spherical bearing rod end which, in peacetime, are expected to find application in shoe machinery, electric fans, textile machinery, automobiles, washing machines, machine tools, and other types of equipment.

The outer casing of this spherical bearing and of the spherical bearing rod end is made of carbon steel for most applications. Inside this casing is a hardened and ground SAE 52100 chromium-steel ball, drilled and ground to a close tolerance for the shaft diameter. Bronze bearing inserts are expanded over the ball, interlocking with the outer casing. A groove is left between the halves of the bronze inserts for oil or grease lubrication.

Some of the outstanding features claimed for this new type of bearing are high carrying capacity, maximum provision for misalignment, and long life. 62



"Centri-Meco Junior" Centrifugal Casting Machine

"Centri-Meco" Centrifugal Casting Machine

Development of a new "Centri-Meco" centrifugal casting machine has been announced by the Centrifugal Machine & Engineering Co., 670 Jackson Court, Kalamazoo 7, Mich. This machine is designed to meet the increasing demand for equipment capable of producing centrifugally formed castings that can be held to closer tolerances. It is claimed that the parts made by the centrifugal casting process have higher physical properties and that they have no hidden defects such as gas pockets, porosity, etc.

It is also claimed that this new machine, equipped with a "Miracle-Hub" bearing, will remain heat-

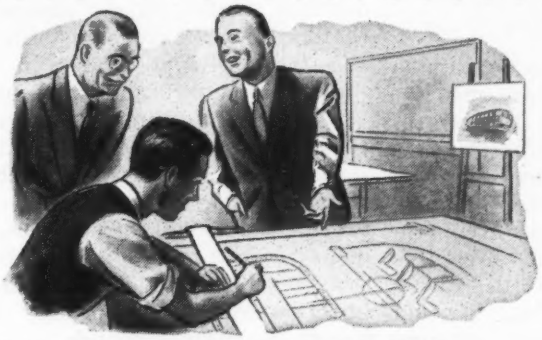
To obtain additional information on equipment described on this page, see lower part of page 196.

BURRS NO LONGER SNAG!

Before Phillips Recessed Head Screws were used for trim and seat assembly in this motor bus, burrs on slotted screws snagged passengers' clothing, caused many nuisance complaints. In spite of extra time for slow hand driving, and smoothing heads, some burrs got by.

NO ASSEMBLY LAG!

With Phillips Screws, burr-trouble ended, and *savings* began – as much as 40% in assembly time and labor, because power driving became practical. Also saved was the time formerly wasted disassembling, refinishing, and reassembling parts scarred by driver skids.



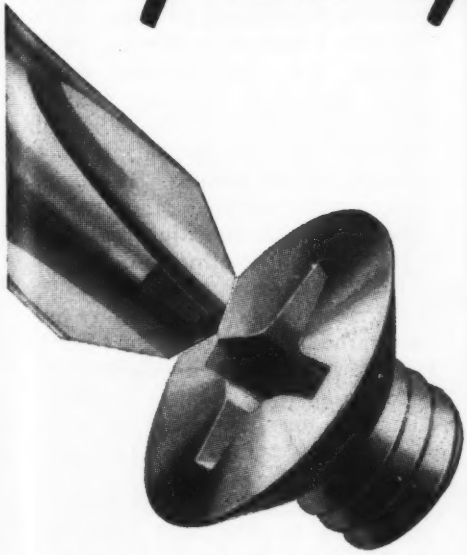
PLANS GET O.K. TAG!

Because Phillips Recessed Head Screws take heavier driving pressures without danger of burring, driver skids, or slant driving, fastenings are stronger, more rigid than with slotted screws. Designers are freed of slotted head handicaps, can often reduce number of screws needed.

APPROVAL'S "IN THE BAG"!

Burr-free Phillips Screws are not only kind to clothing . . . the Recessed Head on exposed surfaces looks better, blends with the practical smartness of modern design. Give your product this cost-trimming, customer pleasing sales appeal!

It's Phillips — the engineered recess!



In the Phillips Recess, mechanical principles are so correctly applied that every angle, plane, and dimension contributes fully to screw-driving efficiency.

. . . It's the exact pitch of the angles that eliminates driver skids.

. . . It's the engineered design of the 16 planes that makes it easy to apply full turning power – without reaming.

. . . It's the "just-right" depth of recess that enables Phillips Screw Heads to take heaviest driving pressures.

With such precise engineering, is it any wonder that Phillips Screws speed driving as much as 50% – cut costs correspondingly?

To give workers a chance to do their best, give them faster, easier-driving Phillips Recessed Head Screws. Plan Phillips Screws into your product now.

PHILLIPS *Recessed Head* SCREWS

WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOLTS

Made in all sizes, types and head styles

25 SOURCES

American Screw Co., Providence, R. I.
Atlantic Screw Works, Hartford, Conn.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
General Screw Mfg. Co., Chicago, Ill.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
Manufacturers Screw Products, Chicago, Ill.
Milford Rivet and Machine Co., Milford, Conn.
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
The Steel Company of Canada Ltd., Hamilton, Canada
Wolverine Bolt Co., Detroit, Mich.

free in the bearing area during continuous use with permanent molds attached to the heavy table mounting plate. The construction of the new hub is such that the temperature in the bearing area is said never to exceed 125 degrees F. The heavy table has four strut-vanes which act as a fan for carrying away the excess heat.

The machine is mounted on heavy plates for anchoring to the floor. The table mounting plate is 18 inches in diameter, and the heavy plate base is 20 by 42 inches. Double V-belts are used for the table drive. The motor mounting is adjustable for standard belt lengths, and vertical adjustment of the motor is provided to permit accurate alignment of the sheaves. Stepless speed adjustment ranging from 198 to 1290 R.P.M. with a 2-H.P. motor is available; with a 3-H.P. motor, the variable-speed range is increased to from 301 to 1959 R.P.M. Electronic drives can also be installed on custom-built machines where a greater range of higher or lower speeds is required. The weight of this machine is about 725 pounds. 63

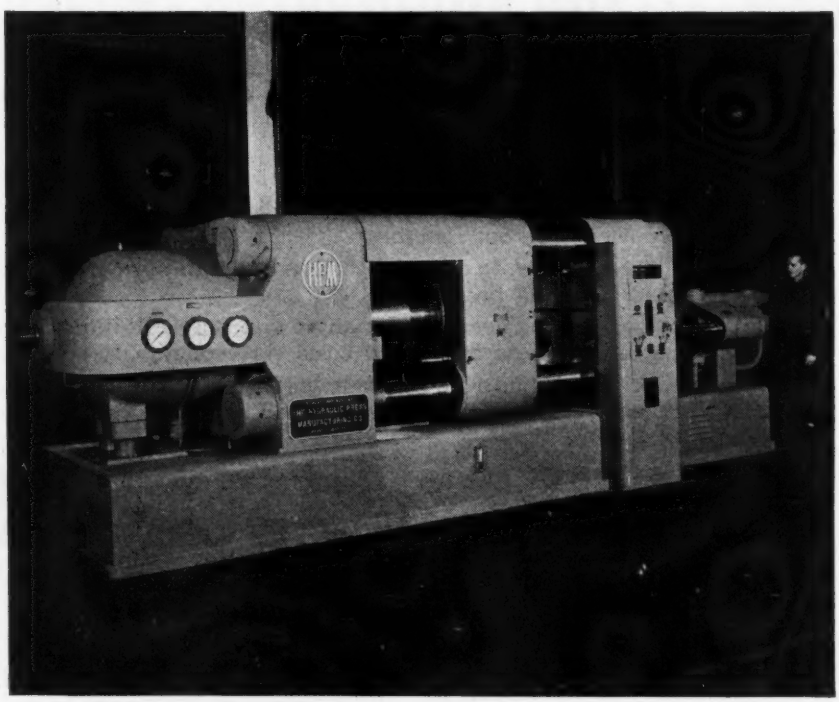
Huge High-Pressure Die-Casting Machine

The Hydraulic Press Mfg. Co., Mount Gilead, Ohio, has just announced the completion of what is said to be one of the world's largest high-pressure die-casting machines. This massive "all-hydraulic" machine is designed to cast 14.88 pounds of aluminum alloy per "shot" at an injection pressure of 25,000 pounds per square inch. An aluminum casting of this weight represents a volume of 154 1/2 cubic inches.

To appreciate more fully the possibilities of this new H-P-M die-casting machine, its injection capacity of 14.88 pounds should be compared with that of 2.4 pounds, which is the maximum 25,000 pounds per square inch injection capacity of the largest regular standard high-pressure machine previously built. Since the majority of high-pressure aluminum die-castings are produced with injection pressures ranging from 10,000 to 12,000 pounds per square inch, it would seem possible that this machine could be successfully employed in the production of aluminum castings weighing 30 pounds or more. One of the principal advantages of this new machine is the ability to produce interchangeable high-quality parts at a very high rate and to shape them so precisely as to reduce finishing operations to a minimum.

The machine is of the same basic design as this company's standard Model 400-A die-casting machine, only much larger in size. Both the mold clamp and injection plunger are actuated by direct hydraulic means. The machine is driven by two hydro-power radial pumps, directly connected through flexible couplings to a 100-H. P. double-end shaft motor, and is completely self-contained. The only connections required to place the machine in operation are electric power and cooling water. The movable mold clamp platen is equipped with hydraulic ejector, and the operating system is designed to use hydraulic core pulls.

The mold clamping pressure is 1000 tons; maximum mounting space for mold, 31 by 56 inches; maximum daylight opening between mold mounting surfaces, 48 inches; maximum mold clamp travel, 24 inches; and maximum injection stroke, 18 inches. The weight is 103,400 pounds. 64



Huge H-P-M High-pressure Die-casting Machine

Bending and Torsion Testing Machine for Sheet Materials

For determining the bending and torsion characteristics of metals, plywood, and plastics, the Baldwin Southwark Division of the Baldwin Locomotive Works, Philadelphia, Pa., has brought out a small universal testing machine designated "No. SF-01-U." This machine has an alternating force capacity of 100 pounds. It is especially well adapted for testing structural and machine parts in both repeated bending and torsion.

An outstanding feature of the machine is that it permits any predetermined alternating load to be kept automatically constant, regardless of the changes in deflection that may occur in the specimen under test. The 100-pound capacity of the machine can be adjusted in increments of 0.2 pound. The speed is 1800 load cycles per minute, and the machine has a maximum bending capacity of 200 inch-pounds and a maximum torsion capacity of 1125 inch-pounds.

When used for universal fatigue testing, this machine will test

To obtain additional information on equipment described on this page, see lower part of page 196.

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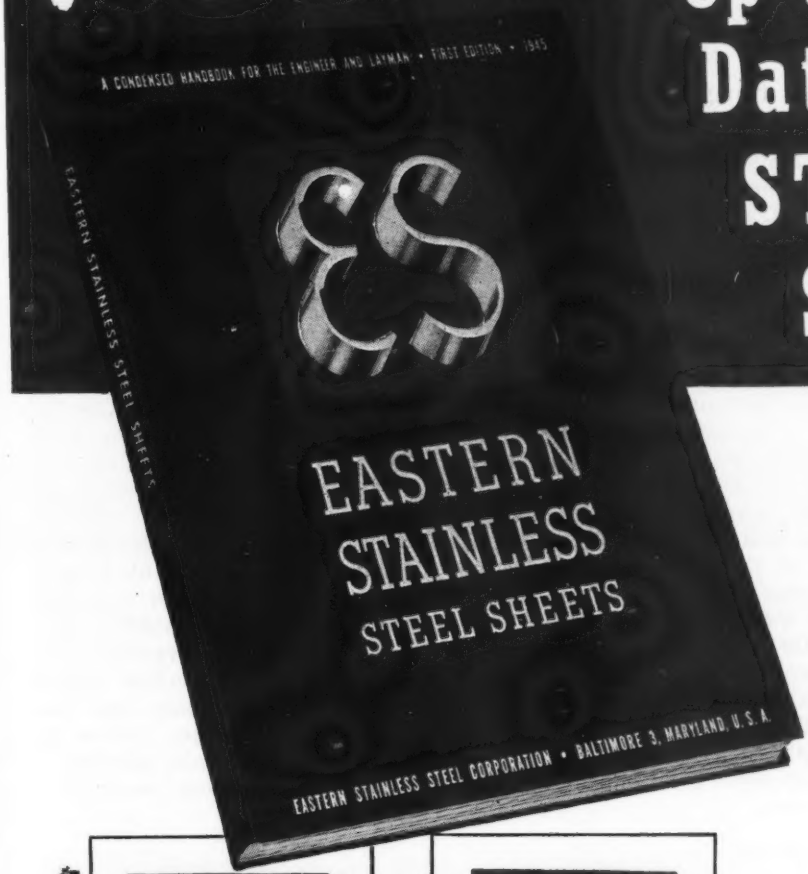
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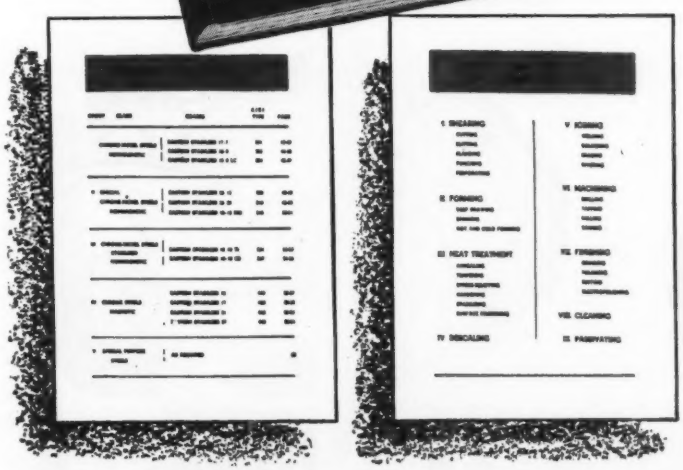

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plastics up to a thickness of 1/2 inch, aluminum alloys up to 3/16 inch, and steel approximately 1/8 inch in thickness. There is ample space for testing bulky assemblies, and the machine can be easily adjusted for various specimen sizes. Tapped holes and T-slots are provided to accommodate special fixtures. The machine is so suspended in the frame as to eliminate the effects of floor vibration.....65

Giant "Maxipres" Developed for the Production of Heavy Precision Forgings

To meet the demands for a press of exceptional capacity for use in the production of large precision forgings, the National Machinery Co., Tiffin, Ohio, has designed and built the huge high-speed forging "Maxipres" here illustrated. This machine, designated No. 7 1/2, is an important addition to this company's line of presses, which previously included sizes weighing from 19,000 to 360,000 pounds, as compared with 800,000 pounds for the new press. Operating at a speed of 50 strokes per minute, this press is capable of producing, in each die impression at one blow, work of the size normally handled on an 8000-pound steam hammer.

Peacetime work for which this machine is adapted includes large wheel hubs, gear blanks, pipe flanges, crankshafts, connecting-rods, side bar links, and bearing races. The press is designed to hold such work to extremely close dimensions, with freedom from draft and with a minimum of flash in order to obtain marked savings in material and machining costs and to increase the output average from two to three times that otherwise obtainable. It is also claimed that the dies used in this machine will have a longer life.

The flow of the metal into the dies is not accomplished by impact, but occurs uniformly. The movement of the metal into the die cavity is continuous, the pressure being gradually increased as the ram of the "Maxipres" nears the bottom of its stroke. There is said to be a maximum "metal flow" into the die with no "splashing" of the hot stock, as in impact forging. It is claimed that this results in a well filled forging with a minimum of flash.

Since there is no impact blow, the dies can be made from high-quality heat-resisting steel without danger of excessive breakage. Also, they can be made with comparatively thin sections. For these reasons, the dies can be made much lighter in weight than those of the impact forging type, which results in lower first costs and also permits better heat-treatment. 66

BuXite Grinding Wheels

"Casehardened" grinding wheels, having greatly increased hardness have been made available by the Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn., after many years of research and tests. The method of producing these wheels, known as the BuXite process, provides the grains of the wheel with a coating. Under the pressure and heat of grinding, this coating changes into a "case" or surface layer of such extreme hardness that it is possible to grind carbide tools and other extremely hard metals with a rapidity never before possible with regular abrasive wheels. The BuXite wheels, it is stated, cut cleanly, and their easy cutting qualities relieve the pressure on the grain, allowing it to cut longer before wearing or

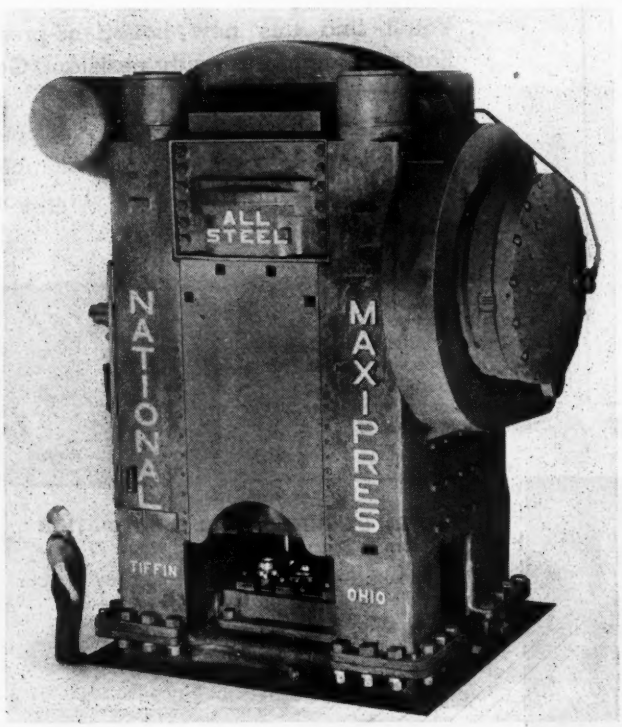


Fig. 1. Above-floor-line View of Giant "Maxipres" Designed for High-speed Forging

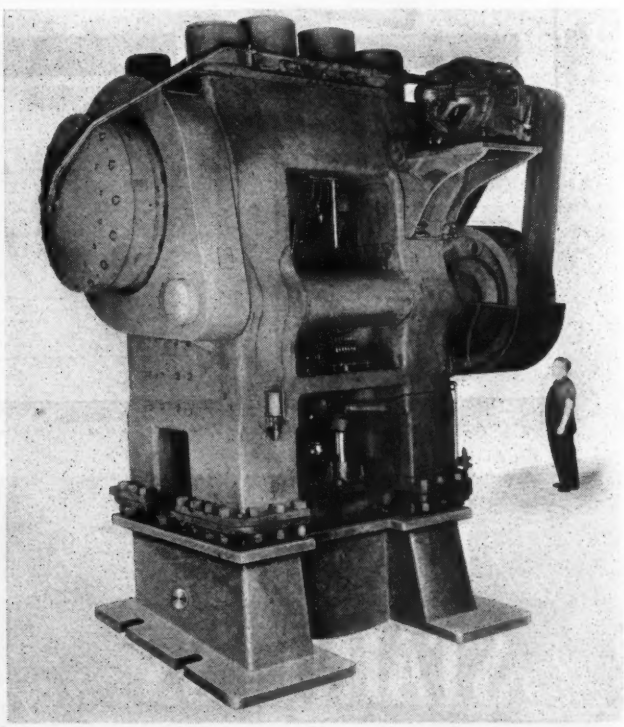
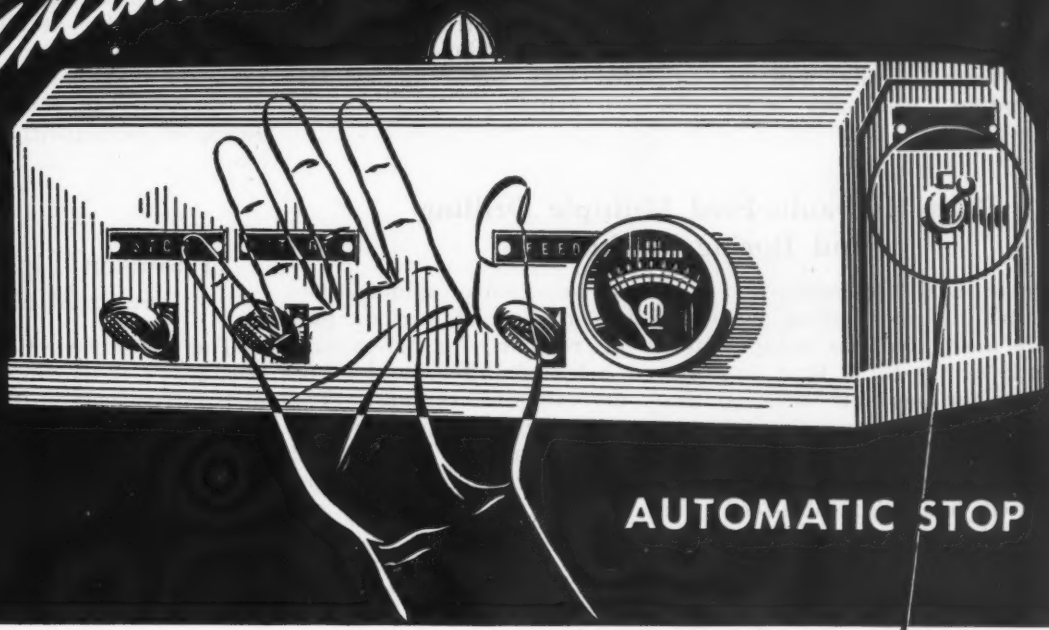


Fig. 2. Rear View of High-speed Forging "Maxipres," Showing Massive Construction

To obtain additional information on equipment described on this page, see lower part of page 196.

Exclusive WITH NEW BRITAINS

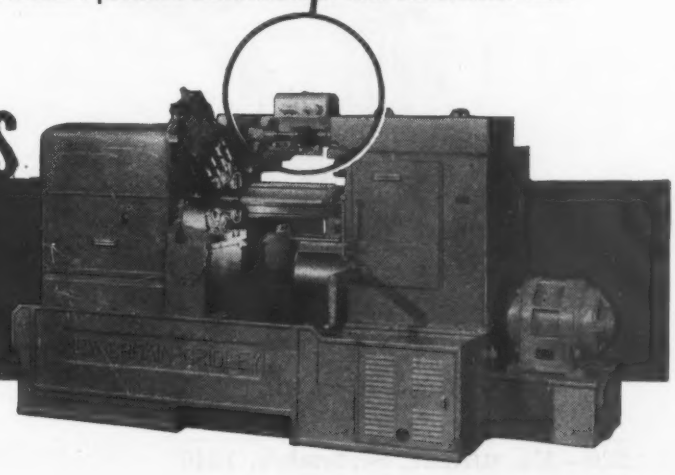


ELIMINATES LOST PRODUCTION

The new electric automatic stop supplied on New Britain-Gridleys is but one of the many outstanding screw machine developments of the era . . . materially facilitating the setting of tools, providing the operator with complete control and assuring the manufacturer of high production efficiency.

When stock is exhausted in any position, the stop mechanism automatically disengages the feed clutch to avert needless machining of the butt end and eliminates costly tool damage. The empty spindle is at the loading station with collet open, slides are withdrawn and a conspicuous red light signals the operator. Reloading is made simple and fast.

Manufacturers employing the most efficient and dependable methods and machines will rely on the automatic stop and other New Britain machine features to help overcome postwar manufacturing and marketing problems. Many can be solved automatically by your nearby New Britain Sales Engineer. Let him prove how New Britains produce more...better and faster...for less.



NEW BRITAIN AUTOMATICS

THE NEW BRITAIN MACHINE COMPANY
NEW BRITAIN, CONNECTICUT
NEW BRITAIN-GRIDLEY MACHINE DIVISION

M-01006

breaking out of the bond. This means a wheel life many times greater than that of unprocessed wheels.

Besides grinding the harder grades of cutting tools, BuXite wheels perform equally well on form grinding, producing more work per dressing. They have also been found to speed up snagging operations to a remarkable extent. The wheels are equally applicable to tool steels, cast iron, brass, and other metals and alloys, and can be employed both for roughing and precision grinding. ----67

operator, so that he can concentrate his attention on loading and unloading. The drilling table is under complete and instant control of the operator at all times, permitting him to start, stop, or reverse the table motion at any point of the feed or return stroke by means of conveniently located foot-levers. ---- 68

Root Hydraulic-Feed Multiple Drilling and Boring Machine

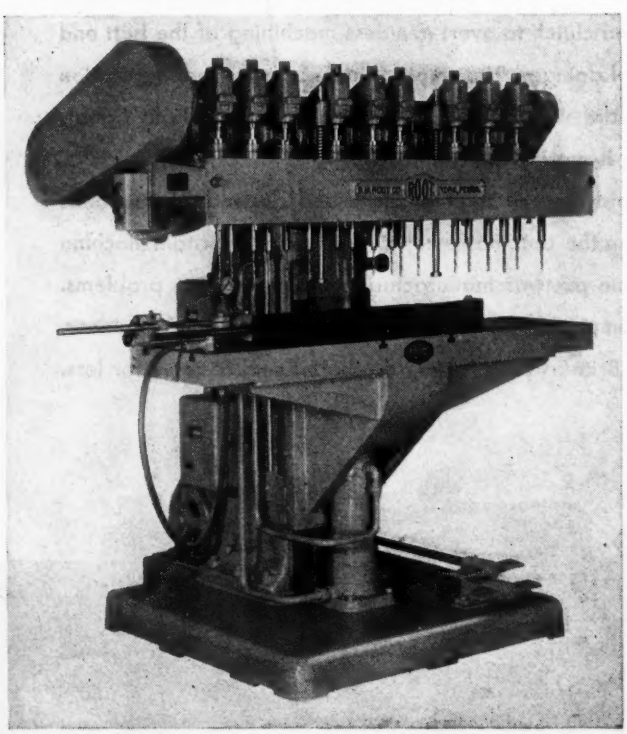
The Style CDH hydraulic-feed multiple drilling and boring machine here illustrated was brought out recently by the B. M. Root Co., York, Pa., for multiple drilling operations in metal, wood, and plastic materials. This wide field of application is made possible by the patented hydraulic table-feed system, which has a range of operating characteristics required for drilling materials of high or low density. It is adapted for drilling accurate duplicate parts on a quantity production basis. The parts drilled are interchangeable and uniform within close limits of accuracy. Production can be accelerated in many instances by attaching a simple jig to the boring table in order to permit drilling several stacked pieces in one feeding movement.

A wide selection of spindles permits the drilling of various patterns of regularly or irregularly spaced holes of different sizes on close or extended centers. The types of equipment available include single spindles, cluster drill heads for intricate close-center work, and single and double expansion spindles.

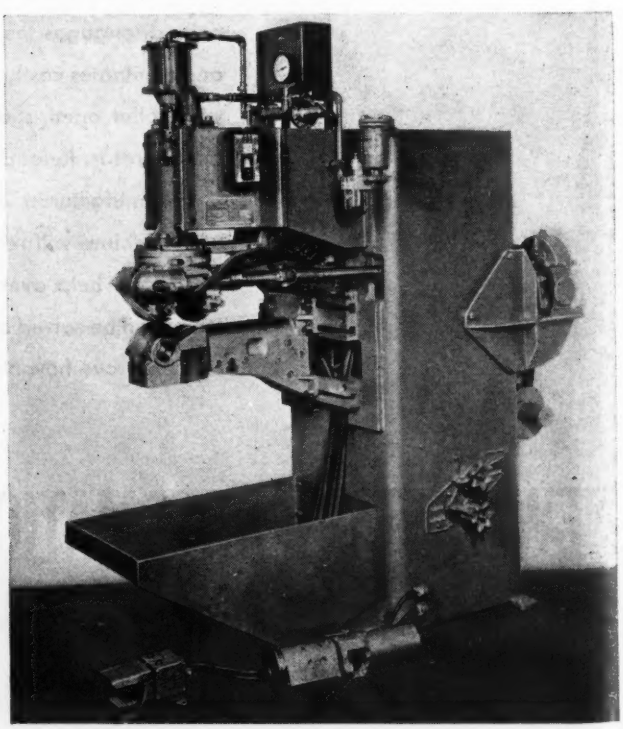
The table can be made of laminated wood or metal. The metal table can be furnished with a coolant system if desired. The hydraulic system for actuating the table can be set for full-automatic or intermittent operation. Stepless variation of the feed rate makes it possible to employ precisely the correct feed for the work being handled. This permits the machine to be timed to suit the normal working speed of the

Thomson Light-Duty Seam-Welder

The Thomson-Gibb Electric Welding Co., Lynn, Mass., has just introduced on the market a new light-duty seam-welder known as Model 6. This welder is intended for the high-speed assembling of two thicknesses of clean, light-gage mild steel stock ranging from 30 to 18 gage in thickness at production speeds up to 20 feet per minute. It can be employed for circular or longitudinal welds, or it can be used as a universal machine, equipped with swiveling upper head and interchangeable lower arm as shown in the illustration, for rapid conversion from circular to longitudinal seam welding. The welder is available in various throat depths and transformer capacities to suit the work.



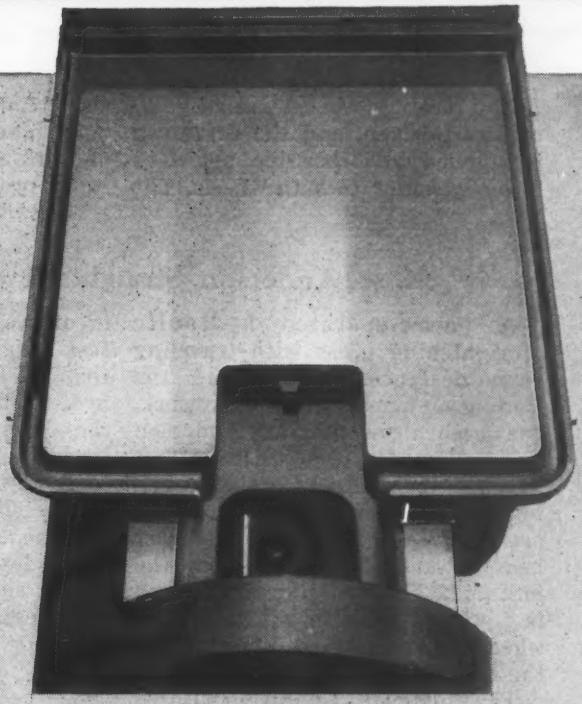
Root Multiple-spindle Drilling Machine



Thomson High-speed Seam-welder

To obtain additional information on equipment described on this page, see lower part of page 196.

HERE'S WHY WE CALL IT *The* SIMPLIMATIC

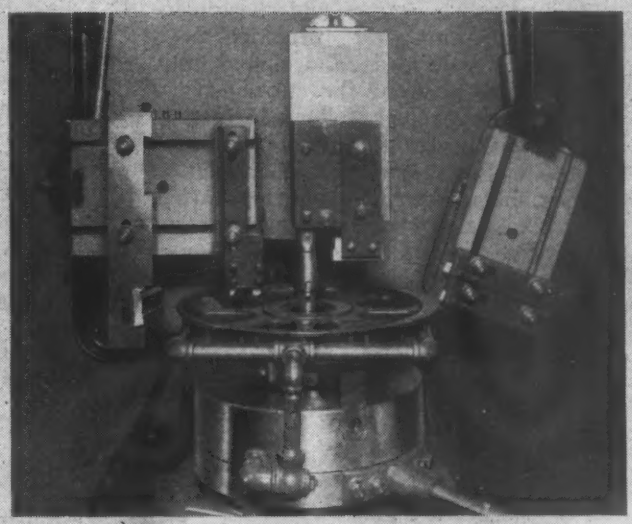


Its simplicity starts with this first basic idea: The use of this large horizontal table which makes it possible to place every tool in its most favorable working position. Here, a greater number of slides can be used. A greater variety of positions is possible. Angle feeds are no problem. Compound slides are unnecessary.

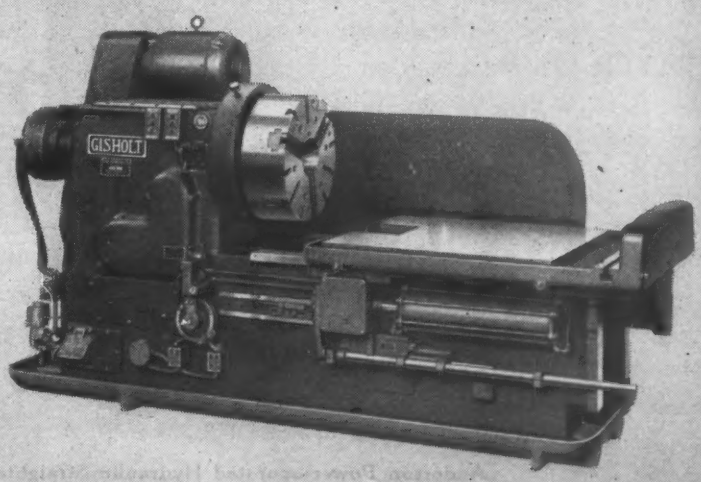
Tool set-up is simpler and more effective. With each slide individually cammed, all slides are independent of each other as to approach, order of engagement with work, rate of feed, dwell, and retract.

Only one simple lever is required to control the complete cycle of machining operations. It doesn't take skill to keep this automatic lathe turning out work swiftly and within the limits.

"SIMPLIMATIC" really describes this simple automatic lathe. If you have parts in volumes to justify its use, get all the facts about it. Write for literature.



With this typical Simplimatic tool set-up, turning and shaving the tapered outside diameter, boring, facing, grooving and chamfering are done simultaneously, in one operation. Tools are quickly and easily adjusted for a variety of sizes.



GISHOLT MACHINE COMPANY
1209 *East Washington Ave.* • *Madison 3, Wis.*

GISHOLT

Look Ahead . . .
Keep Ahead . . .
With Gisholt Improvements in Metal Turning

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES • SPECIAL MACHINES

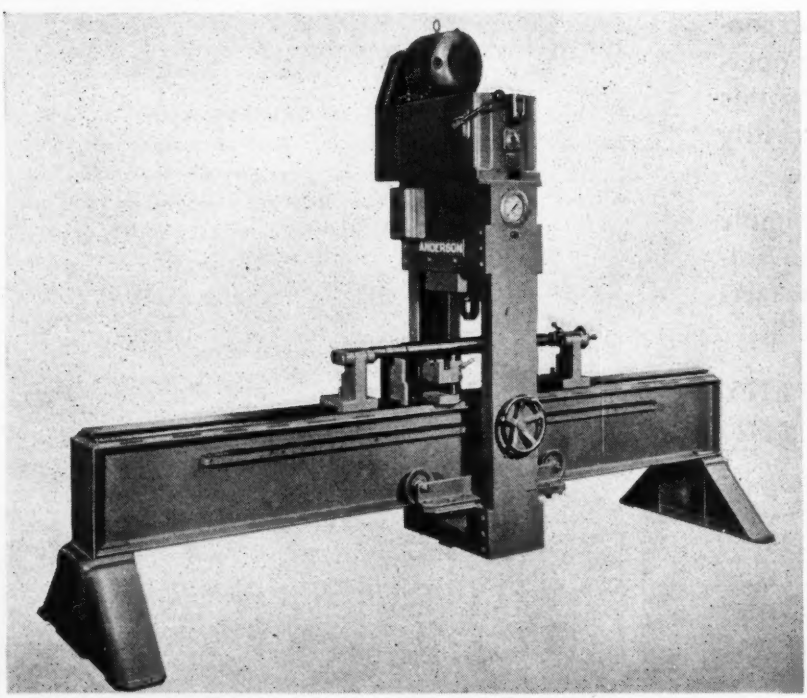
The welding wheels can be gear- or knurl-driven, and the drive can be applied to either the upper or lower wheel or to both wheels. The electronic current timing control is designed to handle a wide range of work and to assure uniform and rapid production. ----69

Anderson Straightening Press

A power-operated hydraulic straightening press with traveling ram, designed to facilitate the loading or handling of heavy work, has been developed by Anderson Bros. Mfg. Co., 1907 Kishwaukee St., Rockford, Ill. With the traveling ram located at one end of the press, the crane can be used to lower heavy work into place on the machine. The traveling ram, which is equipped with four ball-bearing wheels, can then be easily rolled into the required position over the work.

The table is equipped with a V-slide on which are mounted spring-loaded centers and checking rolls. The indicator with which the press is equipped is designed to eliminate much of the cut-and-try procedure generally followed in performing the straightening operation by showing the amount of run-out, the point at which to stop the shaft and apply straightening pressure, and the amount the shaft is being bent. After the pressure is released, the indicator shows exactly what effect has been produced as a guide for the next operation.

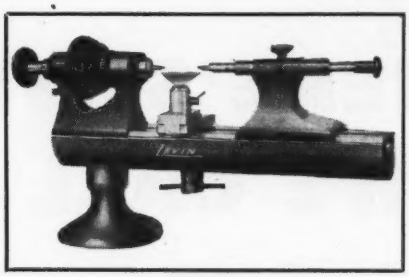
The bed of the standard machine is of welded construction and 11 feet long, but the length can be changed to suit requirements. The hydraulic unit is manufactured by the John S. Barnes Corporation, Rockford, Ill., and was designed especially for this straightening press. The ram has a stroke length of 6 inches, but presses with longer stroke lengths can be furnished. A 3-H.P. motor is required to operate the press. ----70



Anderson Power-operated Hydraulic Straightening Press

Levin Precision Bench Lathe

A precision bench lathe, designed for use by instrument makers, model makers, toolmakers, or production departments where small or delicate work is handled, has been brought out by Louis Levin & Son, Inc., 2206 Beverly Blvd., Los Angeles 4, Calif. The new lathe has a hardened steel spindle and bearings of the double-cone type. The swing is 3.94 inches, and the length of the bed is 12 inches. While this tool is ruggedly built to withstand continuous use, it has the necessary sensitivity for the most delicate watch or instrument work.



Precision Bench Lathe Built by Louis Levin & Son, Inc.

The bed is ground to a master gage, and is provided with a binding bolt. The tip-over hand-rest used in hand turning is made with a well fitted joint to eliminate any play or looseness. The headstock pulley is provided with sixty holes for use in indexing operations. Such accessories as a compound slide rest, milling attachment, and traverse grinding attachment are available. ----71

Ellwood Improved Cutting Electrode

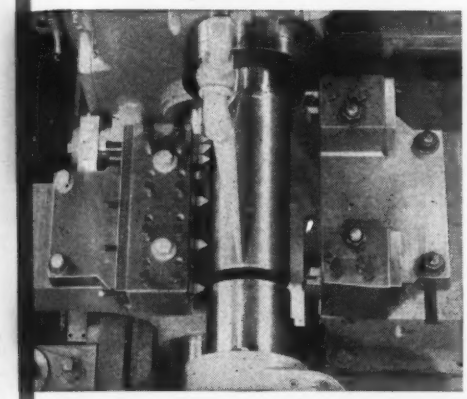
An improved type of cutting electrode that is designed to permit greatly increased speed in metal cutting and can be used at unlimited depths under water has just been placed on the market by the Ellwood Products Corporation, Ellwood City, Pa. It is claimed that any unskilled workman can successfully cut metal with this electrode after only ten months' instruction. The new electrode, known as the "Ellpro," was developed primarily for use in salvaging damaged ships. It is made of steel in the form of a hollow tube with an adhesive type coating which prevents it from sticking to the cutting surface. This electrode is used with oxygen to insure maximum safety for the operator at any depth under water, and can be used with either alternating or direct current.

A molten arc is obtained the instant the electrode is placed against the surface to be cut. In underwater cutting, the oxygen gas, when reaching the surface of the water, does not explode or burn with a large flame. ----72

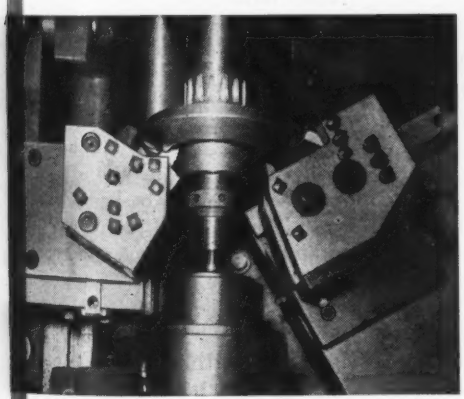
To obtain additional information on equipment described on this page, see lower part of page 196.

AN AUTOMATIC LATHE

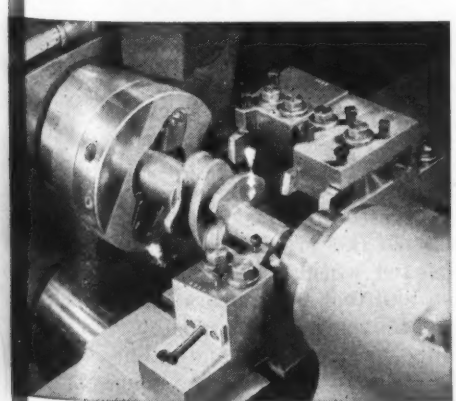
can be versatile too!



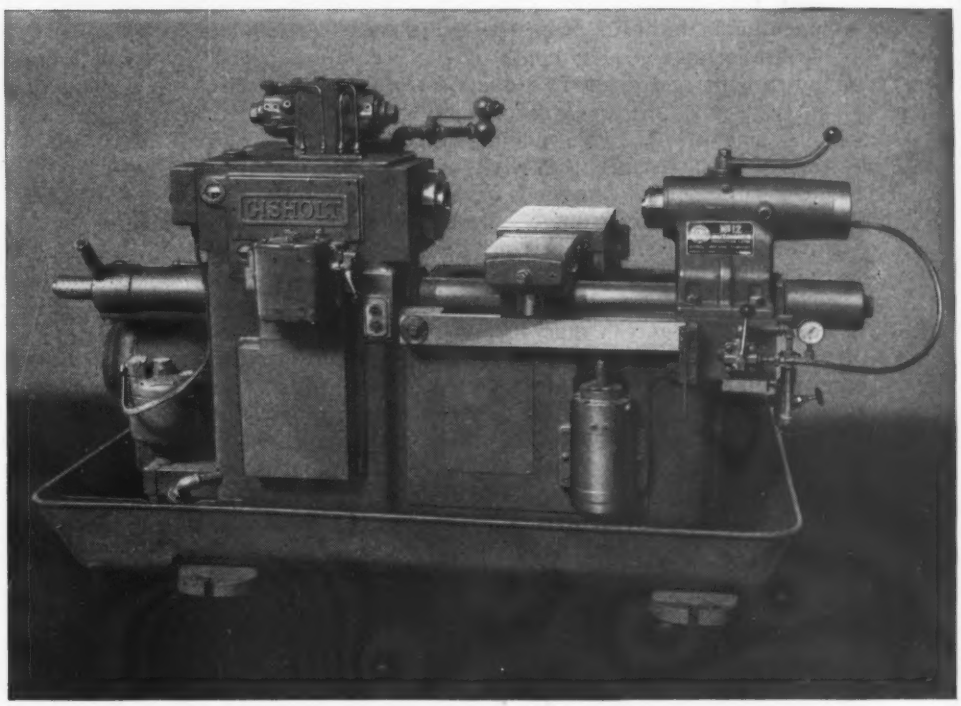
Machining Diesel cylinder liners. Automatic tool relief and fading out tool pressure at point of overlapping cuts, eliminates rings and grooves in the finished surface.



Bevel gears and other work having angular surfaces are machined without auxiliary slides, cams, taper attachments, etc., because rear slide can be set at any angle.



On crankshaft jobs like this, heavy turning and cheek facing with rough intermittent cuts are readily handled with real power and all-around rigidity.



THE GISHOLT NO. 12 HYDRAULIC

demonstrates it!

On this modern automatic lathe, independent hydraulic feeds are provided for front carriage and rear slide, assuring smooth constant feeds with an infinite selection from ".000 to .060." Both slides are heavy and wide, permitting ample room for substantial multiple tool blocks.

On the front carriage, the top slide is equipped with micrometer dial and screw for easy adjustment of tools. Simple cam plates may be applied to the carriage support bar for special contour and taper turning. Rear slide may be set in any position for facing, turning or machining of angular surfaces.

Slides feed against and dwell at positive dead stops, insuring utmost precision. Elimination of feed gears, mechanical trips, cams, etc., greatly simplifies changes of set-up.

GISHOLT MACHINE COMPANY
1209 *E. Washington Ave. • Madison 3, Wisconsin*

Look Ahead . . . Keep Ahead . . . With Gisholt Improvements in Metal Turning

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES • SPECIAL MACHINES

Landis Universal Grinding and Tool Sharpening Machine

A completely redesigned 12- by 28-inch universal grinding machine, which will handle cylindrical, internal, taper, and surface grinding work, as well as tool sharpening and form tool grinding, has been announced by the Landis Tool Co., Waynesboro, Pa. This machine is built to meet the very close tolerance requirements of the instrument and aircraft industries.

Headstock design features of this machine include variable-voltage drive; combination live and dead spindle, so designed that it is unnecessary to change belts or guards when changing from live- to dead-spindle operation; and work speeds controlled by a dial on the front of the machine.

Starting and stopping of the work and operation of the traverse movements are independently controlled by a single lever. This lever is arranged to automatically disengage the hand traverse when the table is operated by power. The design of the footstock fully protects it from water and grit. The swivel table has a large inverted vee to insure correct alignment of headstock, footstock, and various fixtures, and can be swung 180 degrees on a hardened and ground tapered pin.

The four-speed power traverse drive has a very accurate reversing mechanism which is fully enclosed in the bed. The hand traverse has one speed for rapid movement and an extremely fine feed for shoulder and form tool grinding. The wheel-spindle is driven through V-belts by a finely balanced motor mounted in a low position at the rear of the column. The hardened and ground wheel-spindle elevating screw is carried on preloaded ball bearings, is completely enclosed, and has a two-piece nut which is automatically adjusted for wear.

The wheel-slide is mounted on a vee and a flat way. The cross-feed is obtained through a hardened and ground fully enclosed screw, operating in a two-piece nut which is automatically adjusted for wear. The cross-feed handwheel is provided with a coarse and an extremely fine feed. The motor-generator set and electrical controls are enclosed in the machine bed. The coolant tank is also cast integral with the bed. A full line of attachments is available. 73

Universal Grinding and Tool Sharpening Machine Built by Landis Tool Co.

"Axiaflo" Circulator Built by Ruthman Machinery Co.

Ruthman "Axiaflo" Circulators

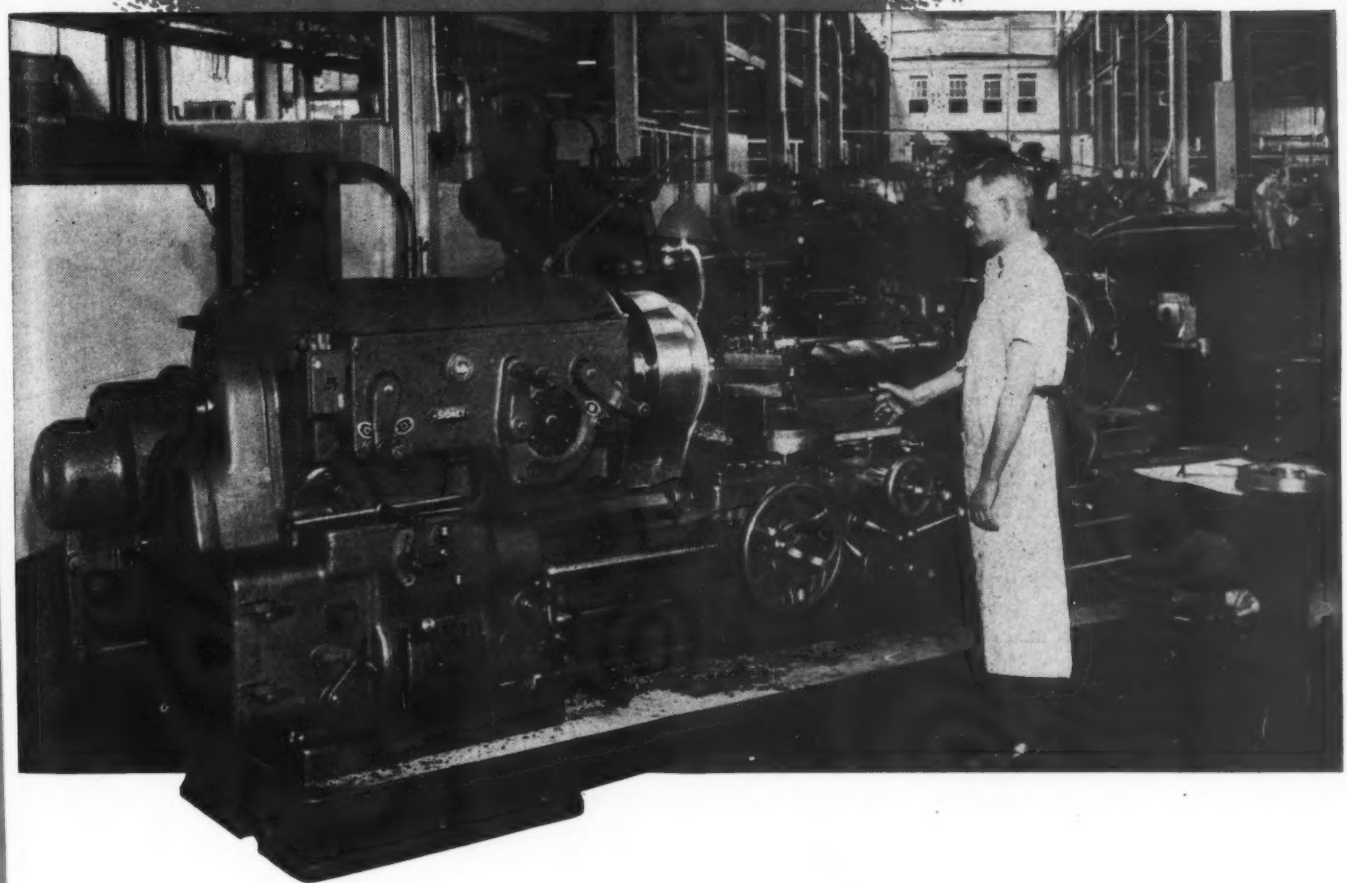
The Ruthman Machinery Co., 1810 Reading Road, Cincinnati 2, Ohio, has recently applied for patents on a new line of "Axiaflo" circulators designed for handling a large volume of liquid at low heads with minimum power requirements. The units are fully ball-bearing equipped, totally enclosed, and have dynamically balanced motors. These circulators are available in a 4-inch size equipped with a 1/4-H.P. motor, and in a 6-inch size with a 1/2-H.P. motor. They cover a discharge capacity range of from 280 to 1200 gallons per minute. 74

Bay State Abrasive Utility Set

A compact package of twelve mounted wheels and points, in sizes most commonly used, has been made available to industry by the Bay State Abrasive Products Co., Westboro, Mass., as a supplement to the present set of twenty mounted wheels and points. Foremen and tool supervisors find these sets convenient for placing commonly used wheels and points at the operator's immediate disposal, avoiding delays and lost tools that hold up production. Packages containing these wheels are identified by red, blue, and black markings.....75

To obtain additional information on equipment described on this page, see lower part of page 196.

SIDNEY LATHE
meets rigid requirements of
MARMON HERRINGTON



● Precision turning, facing and drilling operations are all in a day's work for this 24-inch Sidney Lathe at Marmon Herrington.

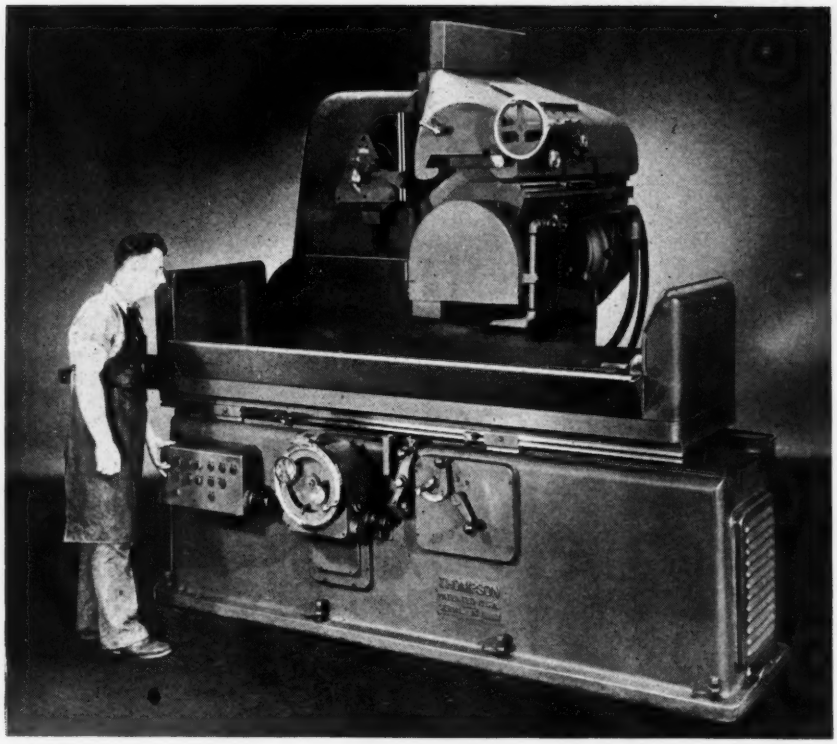
The heavy, rigid base with four-wall construction, amply cross-braced insures the rigidity required to meet precision demands. Also note on this large lathe all controls are easily reached by operator in normal working position.

The continuous tooth herringbone geared head assures a smooth flow of power to the spindle and provides ample power for carbide high-speed tools.

For your precision turning, boring and similar operations put your work on a Sidney Lathe.

Bulletins on all sizes available.

The SIDNEY MACHINE TOOL COMPANY
Builders of Precision Machinery
SIDNEY . OHIO
ESTABLISHED 1904



Thompson Dual-purpose Automatic Grinder

Thompson Crush Form Contour Grinder

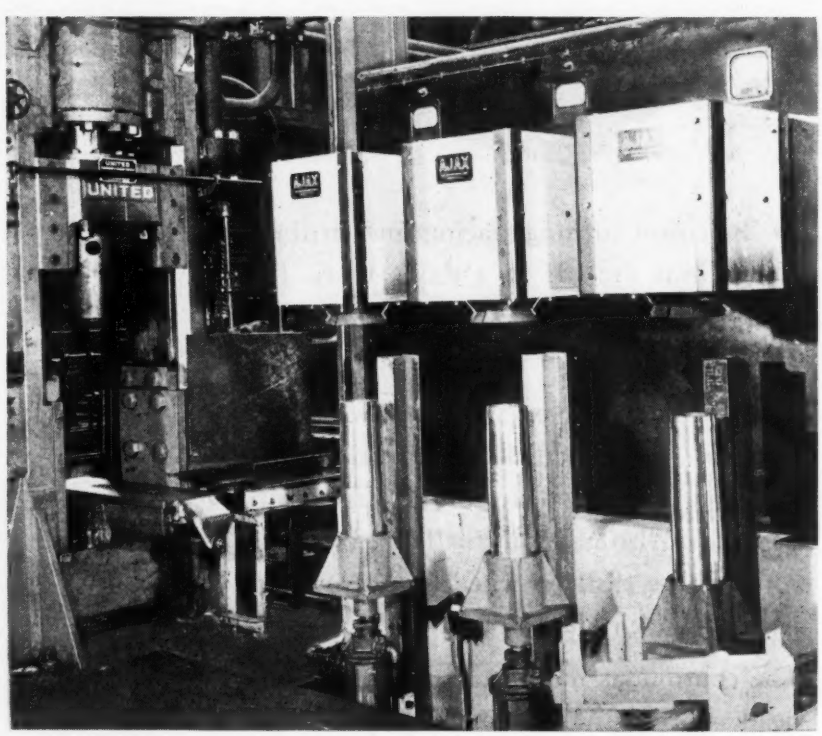
A new dual-purpose machine designed for crush form-grinding precision contours and for mass production on conventional surface grinding work has been developed by the Thompson Grinder Co., Springfield, Ohio. Design and operating features incorporated in this machine are the result of ten years experience in the laboratory development of crush form-grinding precision contours on surface grinders. This grinder can be furnished for operation as a semi-automatic or as a fully automatic machine.

The particular machine shown in the accompanying illustration is designed for mass production, and is equipped for electrically actuated and controlled grinding and crushing cycles, which are completely interlocked. Aside from lowering of the head to establish contact between the wheel and the crusher roll for crushing and truing, the operation is fully automatic. After the original set-up has been completed, the operator simply presses a series of starter buttons to put the machine through its various cycles of operation. Automatic control includes down feed, spark-out, up feed, table reversing, and table positioning for starting work and crushing or truing. Automatic cross-feed is also included, but it is used only when the machine is employed for conventional surface grinding.

The original master crusher roll is formed in the Thompson crush form contour grinding laboratory under conditions developed to assure exact conformance of the contour to the manufacturer's specifications. Duplicate master rolls can be furnished for the machine or they can be made on the duplicating device supplied on the grinder. ---------- 76

Automatic Induction Heating Equipment for Forging Operations

Ajax-Northrup induction heaters, designed to speed up the heating of bars or tubes for forging, upsetting, or spinning operations, which can be installed right in the production line, are now available from the Ajax - Electrothermic Corporation, Ajax Park, Trenton 5, N. J. To facilitate handling work of this kind, the heaters are mounted vertically on a compact control member. The part to be heated is held in a fast-loading holding cup and thrust up into the heating coil by a pneumatically operated ram. Power is applied, and automatically cut off when the exact temperature is reached. The pneumatic ram then lowers the heated piece, which rolls on conveyors to the forging machine.



Ajax-Northrup Induction Heating Equipment for Press Work

To obtain additional information on equipment described on this page, see lower part of page 196.

CHICAGO CUT-OFF WHEELS

From the swift era of war production comes another modern miracle, the cut-off wheel—man power and man hour saver—for the fastest, smoothest method of cutting tubing, wire, steel and brass sheets, glass, porcelain, Stellite, tungsten, plastics, laminates and other hard-to-slice materials.

When RT, the special formula bond was developed, it put the cool-running CHICAGOS 'way out in front in real performance records.

Available in rubber or resinoid—a full range of styles and sizes. 3 bond types—for every operation.

WANT TO TRY ONE? Tell us what you have to cut, grinder you use and size wheel you'd like. We'll send a test wheel promptly. *Write for Circular.*

CHICAGO WHEEL & MFG. CO.

Originators of the famous Chicago Soft Rubber Polishing Wheels

1101 W. Monroe St., Dept MR, Chicago 7, Illinois

MADE WITH RT

THE NEW BOND THAT HOLDS ITS OWN . . . GIVES ONLY WHEN IT MUST!

Send CIRCULAR____ SEND TEST WHEEL____ SIZE____ TO CUT____

NAME_____

ADDRESS_____

CITY_____ STATE_____ MR

The installation illustrated, consisting of three heaters and their control unit, is located at the plant of the United Engineering & Foundry Co. Two of the heaters are kept in operation while the third is being unloaded and reloaded. The pieces are handled at the rate of one piece per minute for each heater, the power source being a 250-kilowatt motor-generator. The controls are simple to operate, and provide split-second automatic timing.

Each piece receives exactly the same treatment, which consists of top heat at the end, tapering off toward the unworked portion. When placed in the press, the metal thus heated flows smoothly while being formed to the correct shape. Practically any differential heating pattern can be achieved by proper design of the heating coil. A negligible amount of scale is produced by this heating method, resulting in longer life for the press dies. The equipment can quickly be converted to handle many different heating operations by simply changing the heater taps and the time cycle or by substituting inexpensive heaters of different sizes. 77

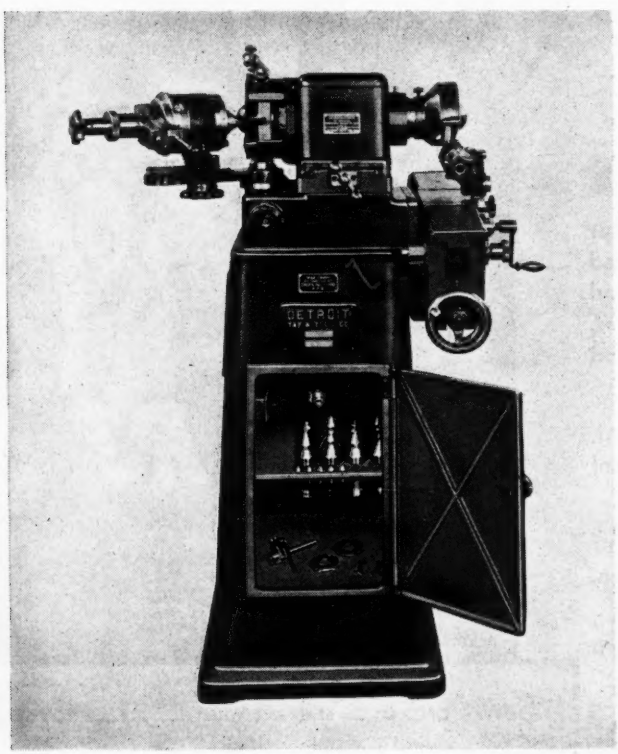
Improved Tap-Conditioner

Increased flexibility and a wider range of capacities for reconditioning taps ranging from the small machine-screw sizes up to 1 1/2 inches in diameter are features of the improved tap-reconditioner recently placed on the market by the Detroit Tap & Tool Co., 8432 Butler Ave., Detroit 11, Mich. All operations for keeping taps in first-class condition can be performed on this machine, which provides facilities for full-range chamfering, spiral pointing, point polishing, and grinding the full length of tap flutes. Taps having from two to seven flutes can be chamfered. Flutes and spiral points can be ground on taps having from two to six flutes. All sizes and types of taps can be point polished.

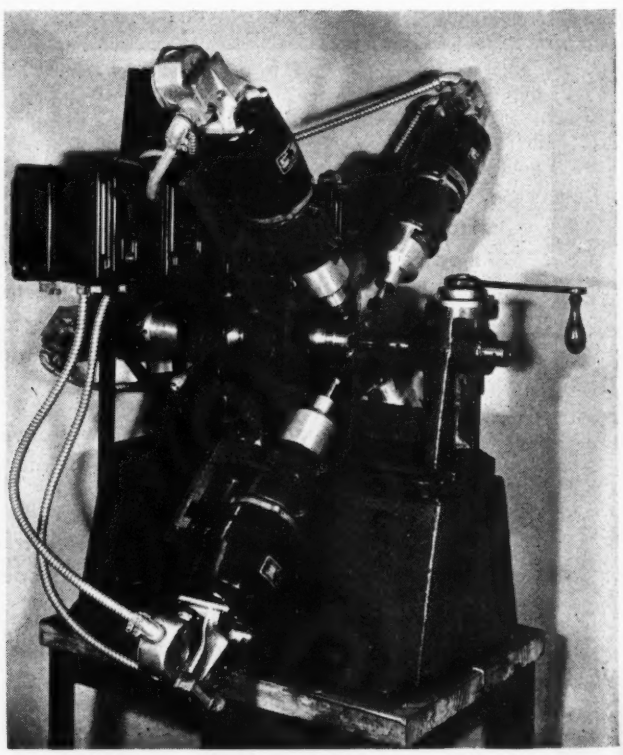
A high-precision spindle head permits using a wide range of motor types for the various service voltages, frequencies, and phases of electric current available in different plants. Increased spindle-head rigidity and continuous adjustability to compensate for grinding-tool wear are provided by mounting the spindle assembly on large dovetail ways in the pedestal base. A large compartment in the base affords ample storage room for quick-change type collet chucks, which can be used interchangeably on both the chamfering and the flute grinding and spiral pointing units. 78

Simplex Special Five-Unit Drilling Machine

The Simplex Tool Engineering Co., 132 Duffield St., Detroit 1, Mich., has built a special five-unit drilling machine for the simultaneous drilling of five holes in one operation on a small part. An outstanding feature of this machine is the simple clamping fixture arrangement that closes the motor circuits on the five drilling heads simultaneously with the clamping operation. The forward and reverse movement of the drill spindles is fully automatic. These units are made in progressive sizes for drilling holes up to 1/4 inch in diameter. As shown in the illustration, four of the drilling heads are radially positioned around the work in a vertical plane, while one head is located horizontally for end drilling. 79



Improved Tap-conditioning Machine Brought out by Detroit Tap & Tool Co.



Special Five-unit Drilling Machine Built by Simplex Tool Engineering Co.

To obtain additional information on equipment described on this page, see lower part of page 196.

CLEAN CUTS AT HIGH SURFACE SPEEDS

SUNICUT...

Improves Turning, Boring, and Threading Operations On Brass

The right cutting oil for the right operation can make the difference between rejects or parts which meet the most exacting requirements. This was amply proved by a manufacturer of precision parts when he switched from a competitive oil to Sunicut No. 973 for turning, boring, and threading on the following operation:

Type of Machine: National Acme Gridley Automatic Screw Machine; 2⅝" capacity; Model R.B.; Six Spindles.

Material Machined: Commercial Rod Brass
Operation: ..... Machining Booster Body for Fuse
Speed: ..... 400 Surface-Feet per Minute
Feed: ..... .003"
Lubricant: ..... Sunicut No. 973

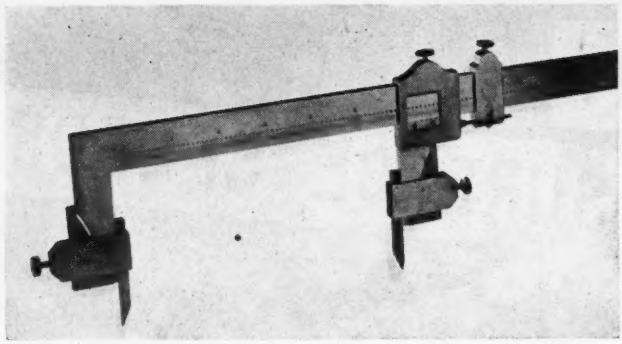
With the competitive oil, it was difficult to maintain accuracy of finished parts. Threads were of poor quality, due to chatter-marks. Rejects ran high.

When a Sun Oil Company Engineer was called in, he recommended a change to Sunicut No. 973. Production increased. Accuracy was held to closer tolerances. Chatter-marks were eliminated. Better threads were obtained. Rejects were greatly reduced.

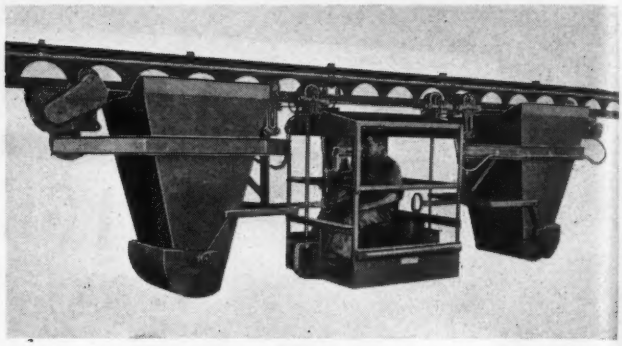
This is just one case taken from the hundreds in Sun's product-performance files. For factual proof of what Sunicut, the clear, transparent, non-emulsifiable cutting oil can do for you, test it in your own plant. Sun Products and Sun Engineering Service are yours to use to improve production. Write . . .

SUN OIL COMPANY • ***Philadelphia 3, Pa.***
Sponsors of the Sunoco News Voice of the Air — Lowell Thomas

SUNOCO **SUN INDUSTRIAL PRODUCTS**
OILS FOR AMERICAN INDUSTRY



Vernier Caliper Equipped with Radii Attachments Made by Modern Machine Tool Co.



Cab-operated Double-bucket Carrier Developed by Cleveland Tramrail Division

Radii Attachments for Lay-Out, Scribing, and Measuring Work

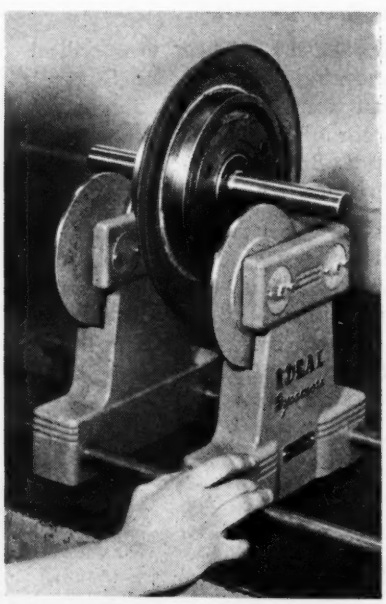
Attachments that can be easily applied to vernier calipers for use in lay-out work have just been brought out by the Modern Machine Tool Co., 7572 E. Robinwood Ave., Detroit 12, Mich. The vernier with these attachments can be set very quickly and accurately to any desired dimension within 0.001 inch. The scribers are made of high-speed steel, properly hardened and accurately ground. The attachments are available in ten sizes to fit verniers up to the 48-inch size. 80

Ideal Balancing Ways

The Ideal Commutator Dresser Co., 1011 Park Ave., Sycamore, Ill., has just announced a new line of super-sensitive balancing ways, designed for precision static balancing operations. The use of scale type bearings in the 10-inch size has made possible sensitivity to 0.007 ounce-inch. Special sensitive bearings used in the 20- and 42-inch sizes enable an accuracy in balancing of 0.009 ounce-inch to be obtained.

The work is carried on free-turning disks mounted on precision bearings. The disks are ground on their work-supporting peripheries. The standards that support the revolving disks can be adjusted on their aligning shafts to take different lengths of work. Solid end castings provide maximum strength and rigidity.

The balancing ways simplify static balancing, straightening, and truing operations on parts such as fans, pulleys, flywheels, crankshafts, grinding wheels, armatures, etc. They are available in four sizes, having 10-, 20-, 42-, and 60-inch swings, with work-supporting capacities ranging from 400 to 5000 pounds. 81



Ideal Balancing Ways

Cab-Operated Double-Bucket Carrier

A double-bucket carrier of the motor-driven overhead cab-operated type has been developed by the Cleveland Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio, for the transportation of dry bulk material. Operation of the carrier and the opening and closing of the bucket gates are controlled by the cab operator from a swivel chair, which enables him to face either of the two buckets.

A single variable-speed drum controller is located on one side of the cab, and two foot-brakes are provided, one at each end, so that one is always in convenient reach of the operator, regardless of the direction in which the carrier is being operated. Push-pull levers for operating the bucket gates extend into the cab and permit emptying the materials as desired.

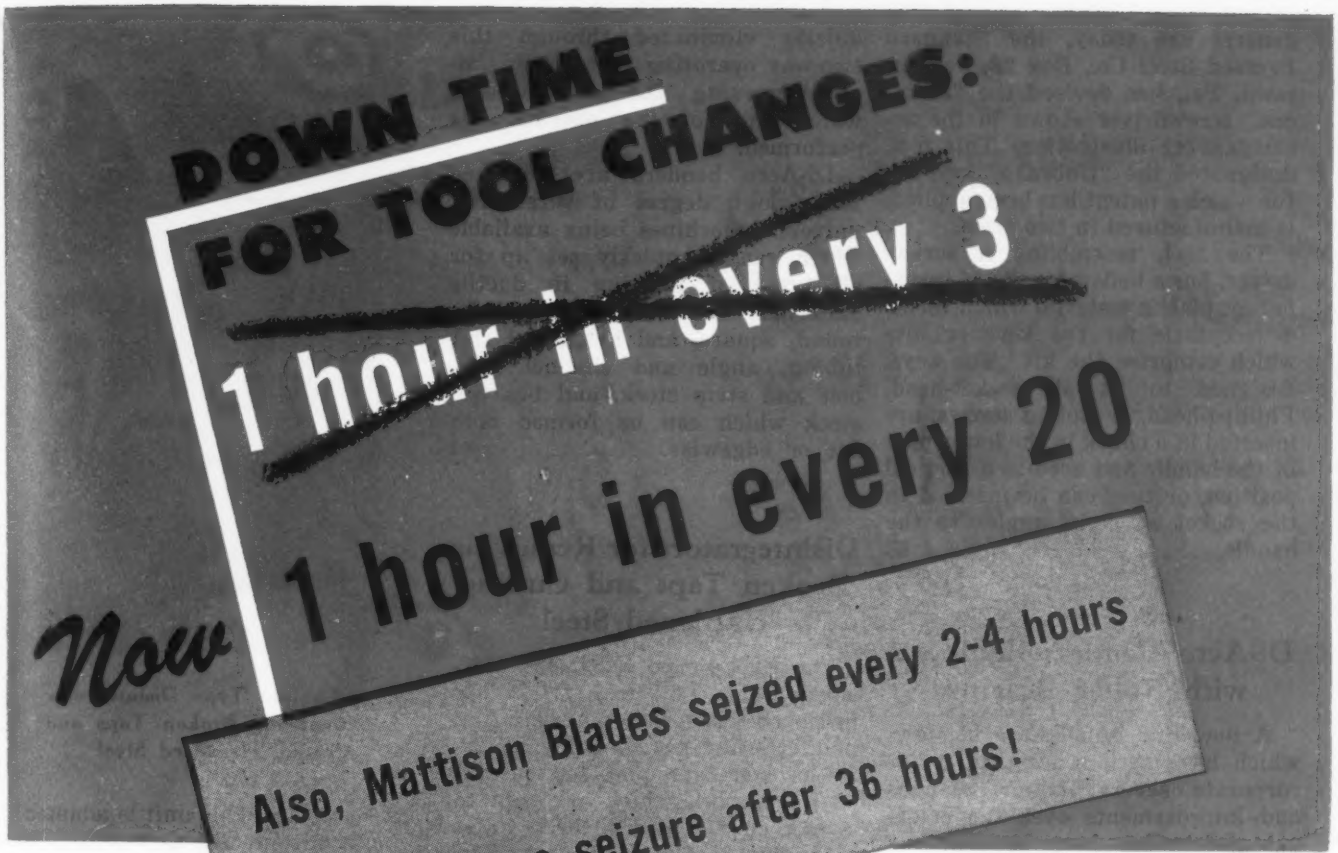
In the unit illustrated, each of the two buckets has a capacity of 25 cubic feet, and the unit is designed to carry a total load of 2 tons. The carrier is provided with two motorized travel drives, one at each end, and operates at speeds up to 600 feet per minute. 82

"Unbrako" Key Kit with Nine Screwdriver Bits

Recognizing the need for one tool to take the place of separate screwdrivers and wrenches for each of the many types of screw-heads in

"Unbrako" Key Kit Screwdriver

To obtain additional information on equipment described on this page, see lower part of page 196.


DOWN TIME
FOR TOOL CHANGES:
1 hour in every 3
Now 1 hour in every 20
Also, Mattison Blades seized every 2-4 hours
Now no seizure after 36 hours!

FINISH IMPROVED 30%

This was done on a 6 spindle Cone Automatic... after switching to QUAKER KUT #45—a new type organic base that replaces conventional cutting oils.

If you are interested in slashing down-time in your plant, a Quaker Process Engineer will be pleased to call and determine whether QUAKER KUT #45 can be adopted successfully in your machining operations. There will be no obligation or cost to you.

QUAKER CHEMICAL PRODUCTS CORP.

CONSHOHOCKEN, PA.

Other Plants in CHICAGO and DETROIT Warehouse Stocks in Principal Industrial Centers

For more details on QUAKER KUT No. 45, fill in below, tear out and mail.

A Progressive Organization of Research and Process Engineers and Manufacturing Chemists

Name_____ Position_____

. . . PLEASE PRINT COMPANY NAME AND ADDRESS IN MARGIN BELOW . . .

general use today, the Standard Pressed Steel Co., Box 22, Jenkintown, Pa., has devised the "all-in-one" screwdriver shown in the accompanying illustration. This tool, designated the "Unbrako" key kit, for which a patent has been applied, is manufactured in two sizes.

The tool, resembling a screwdriver, has a hollow handle of transparent plastic material which forms a receptacle for the keys or bits which comprise the kit. The keys, designed to fit all socket-head, Phillips-head, or slotted screws, are inserted in a chuck in the lower part of the handle and used in a vertical position, or they can be inserted in the socket at right angles to the handle. 83

Di-Acro Benders Equipped with Roller Bearings

A new line of Di-Acro benders, which have been redesigned to incorporate several major changes and improvements over the original models, has been brought out by the O'Neil-Irwin Mfg. Co., 332 Eighth Ave., S., Minneapolis 15, Minn. Operating friction has been greatly reduced in these new benders by the installation of Torrington roller bearings, which are said to have considerably increased the forming capacity of these machines.

The new No. 2 and No. 3 size Di-Acro benders have instantly reversible lever control cams, which allow the machine to be operated either in the right- or left-hand forming direction. Interference that may develop when forming several intricate shapes successively in a single piece can also be quickly eliminated through this two-way operating feature by simply reversing the direction in which the forming operation is performed.

Di-Acro benders are designed for a high degree of versatility, universal machines being available which can be quickly set up for all types of forming in ductile materials, including round, half-round, square, and hexagonal rod, tubing, angle and channel iron, bolt and strip stock, and bus bar stock which can be formed both flat or edgewise. 84

Disintegrators for Removing Broken Taps and Cutting Hardened Steel

The Elox Corporation, 838 Maccabees Bldg., Detroit 2, Mich., has developed three new electrical metal disintegrating machines for removing broken taps and for cutting hardened steel, which are said to have a cutting speed three times faster than that of previous models. These machines are adapted for cutting odd-shaped holes in hardened steel.

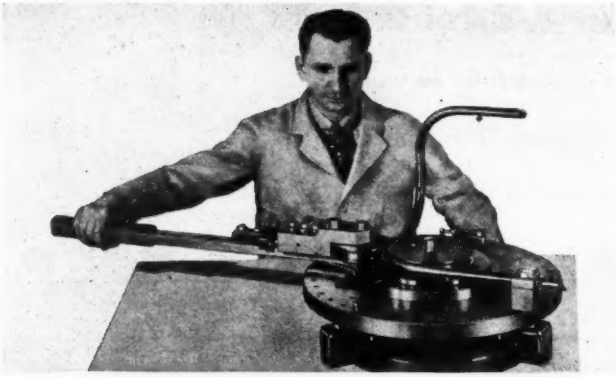
The largest (Type 1) cabinet machine, shown in the illustration, can be easily moved around the shop on casters, being completely self-contained except for the extension cord, which is plugged into the electrical circuit. The compact streamline J unit has a circulating pump, and is equipped to perform the same work as that handled by the larger unit illustrated.

The smallest unit, known as Type G, embodies all the characteristics of the former Type E, in addition to all the features developed for faster cutting. This unit is adapted for intermittent use, as required in small shops. A separate water supply is required for use with this machine. 85

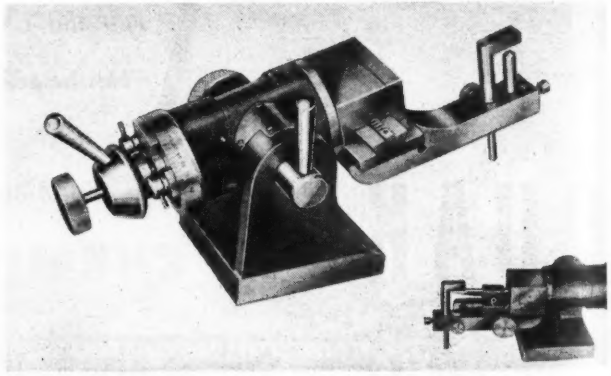
Elox Cabinet Type Disintegrator for Removing Broken Taps and Cutting Hardened Steel

Radius and Tangent Dresser for Grinding Wheels

A new radius dresser (No. 150), designed to provide complete wheel-dressing service, including facilities for dressing an angular surface tangent to a radius formed surface, is a recently announced product of the U. S. Tool & Mfg. Co., 6906 Kingsley Ave., Dearborn, Mich. With this one instrument, the operator can dress the wheel



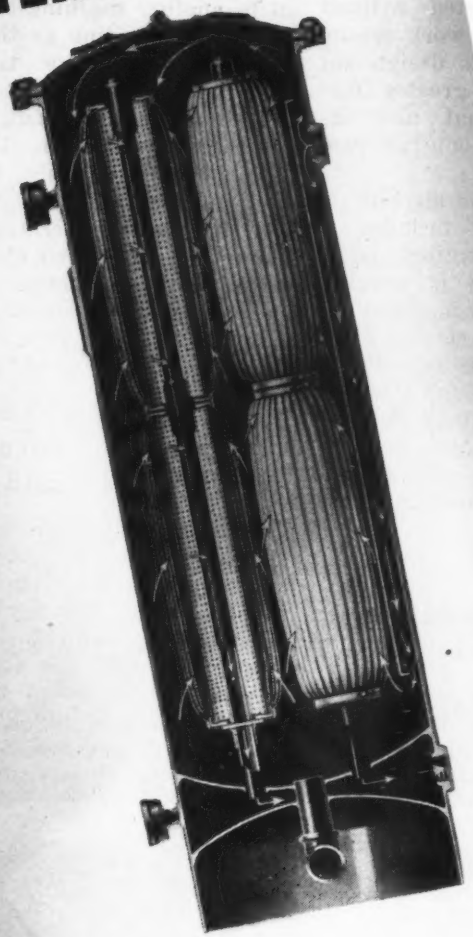
Improved Model Di-Acro Bender Equipped for Bending Tubing



Grinding Wheel Dresser Brought out by U. S. Tool & Mfg. Co.

To obtain additional information on equipment described on this page, see lower part of page 196.

BRIGGS COOLANT FILTERS PROVIDE . . .



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REDUCTION OF REJECTS . .

LONGER COOLANT LIFE . .

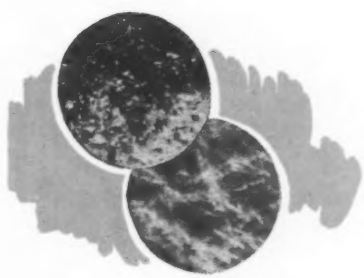
FEWER TOOL OR WHEEL DRESSINGS . .

In every shop where Briggs Coolant Filters have been installed, they have proved that effective coolant filtration pays dividends . . . the dividends you want in your shop.

No wonder Briggs Filters do a better job—they are designed especially for filtration of coolants! The unique Z-fold refill is capable of removing even the smallest particle of grit.

Briggs Coolant Filters are available for capacities ranging from 3 GPM to 100 GPM—for installation on unit machines or in central systems.

Learn why and how Briggs Coolant Filters do a better job of coolant filtration. The Briggs distributor nearest you can tell you. Look him up—he's listed in the "Filters" section of your classified telephone directory, or write direct to:



BEFORE and AFTER

At left is shown dirt deposit on filter paper before filtration—at right, note absence of dirt after coolant passed through a Briggs Coolant Filter.

Briggs

PIONEERS IN MODERN OIL FILTRATION

BRIGGS CLARIFIER CO.

General Offices, Washington 7, D.C.

to a radius, an angle, a compound-complex angle, and an angle tangent to a radius in one operation. When these four operations are performed, the primary diamond-holder position is used, but provision has been made for forming extremely small or large radii in the section of the wheel in cases where the radius must extend over a full half circle, or an arc of 180 degrees. For this work, an accessory is used, which consists of a special diamond-holder mounted in the secondary position, as indicated in the reduced-scale view in the lower right-hand corner of the illustration. 86

Fray Milling Machine with Electronic Control for Power Feed

The Fray Machine Tool Co., Glendale 4, Calif., has brought out a new turret-head, ram type milling machine, designated No. 9, which is equipped with a variable-speed power feed operated by means of an electronic control panel, built in as an integral part of the equipment. When used for vertical milling, the head is swung into the position shown in the encircled view of the illustration. When employed for horizontal milling, the ram is positioned as shown in the upper view.

Since this machine can be used both for horizontal and vertical precision milling, almost any operation at any angle or compound angle can be completed without changing the original work set-up. It is claimed that this design not only makes possible greater machining flexibility, but also increases efficiency in long-run production schedules.

Work for which this machine is particularly adapted includes a wide variety of operations on a single piece where it is simpler, faster, and more economical to change the machine setting than to reset the work. It is suitable for precision jig boring, slotting, drilling, tapping, keyway milling, end-milling, profile milling, die-sinking, plastic mold routing, serrating, spot-facing, counterboring, and spline milling. 87

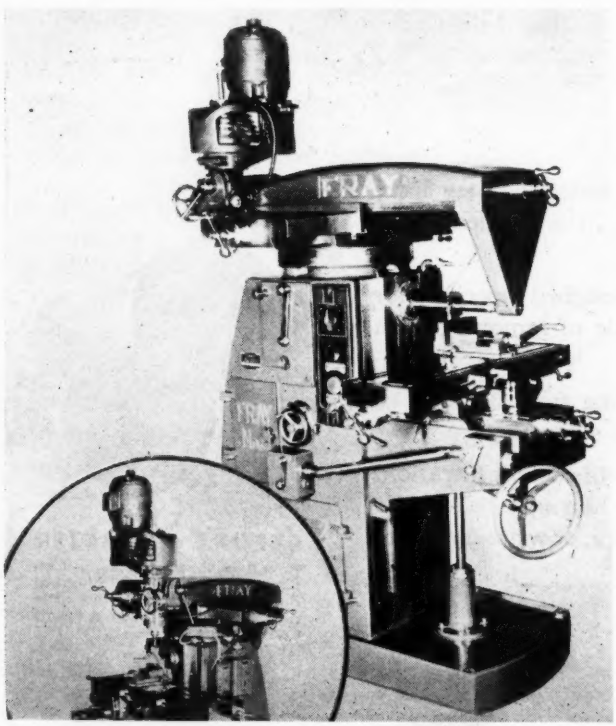
Optimus Washing and Rinsing Unit

A new single-stage washer for cleaning metal parts, which permits rinsing and washing to be done in one unit, has been announced to the trade by the Optimus Equipment Co., 159 Church St., Matawan, N. J. This unit is portable, and can be easily taken to the work, eliminating the need for bringing the work to the machine. It can be readily moved on to another machine or point in the production line as the flow of work is reduced or transferred from one department to another.

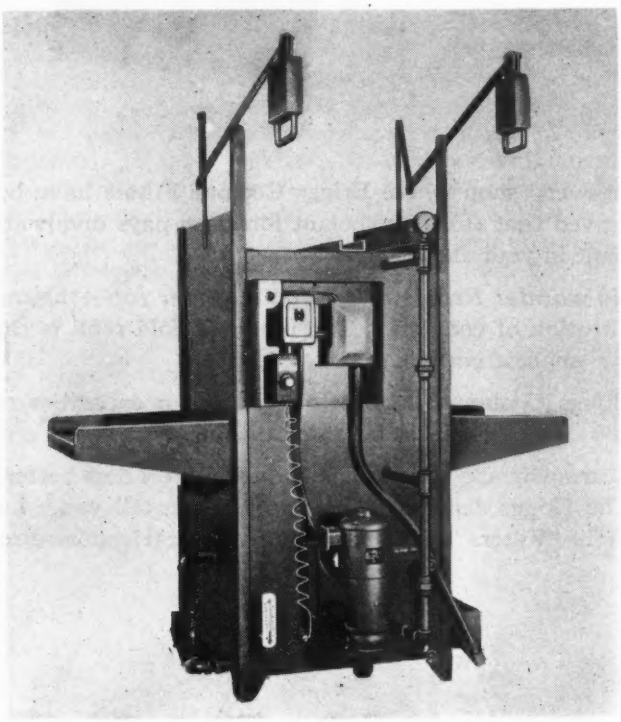
The washer is small, compact, and rapid in operation. It occupies a floor space of only 12 square feet, and is furnished with moving jets and easily operated vertical sliding doors that provide adequate control over splashing cleaning compounds. The unit can be equipped with any type of heating device and heat control. 88

Half-Round Diamond-Impregnated Hand Hones

Since the development of cemented carbides for cutting tools, dies, and wear-resisting surfaces, the finishing of this hard material has always presented a problem. Some years ago, the Oscap Mfg. Co., 207 W. Saratoga St., Baltimore 1, Md., made available a flat metal-bonded diamond-impregnated hand hone for this purpose. This



Fray "All-Angle" Milling Machine with Electronic Control for Power Feed



Optimus Portable Washing and Rinsing Machine Designed for Rapid Cleaning of Metal Parts

To obtain additional information on equipment described on this page, see lower part of page 196.

YOUR GEAR CUTTERS WILL DO

Unless designing gear cutters for every kind of job is second nature to you, it is easy to overlook little things like the fact that an .050" radius on a hob tooth will cut one size of fillet on one size of gear, another size of fillet on a different gear. Or that a shaper cutter with a 14-1/2° pressure angle in the normal plane will not produce a 14-1/2° pressure angle gear due to the sharpening angle. Or that you use the poorest part of the steel for cutting when you design the tool with the shank larger than the hob; or that you usually don't need a Class A hob when a gear is finished by shaving; or that a correctly designed hob protuberance will leave no undercut on gear teeth after finishing.

Obvious? Certainly. Yet these items are taken at random from scores of little things brought to the attention of tool purchasers by Gear Production Headquarters' Engineering Department after the order has been received.

For G-P-H engineering goes beyond designing or selecting a tool to your "order". It analyzes your requirements on the basis of experience in every phase of gear production BEFORE THE TOOL IS MADE.

If it's a G-P-H-engineered gear cutting tool, it is the right tool for the job.

Are you on the Mailing List to receive GEAR PRODUCTION HIGHLIGHTS, regularly? Ask for it on your company letterhead.

ORIGINATORS of GEAR SHAVING

MICHIGAN TOOL COMPANY

7171 E. McNICHOLS ROAD DETROIT 12, U. S. A.

BUY U.S. BONDS STAMPS

company has now added, as a regular product, half-round hones for finishing curved surfaces in form cutting tools, dies, punches, or drawing dies. This half-round hone can be used not only for finishing carbide tools, but for Stellite, high-speed steel, and even carbon steel tools. It can also be used for deburring operations. These tools are made for radii from 3/16 to 1 inch. 89

Blanking and Forming Dies Made from Sintered Carbide

Sintered carbide blanking and forming dies that are said to multiply from ten to a thousand times the number of pieces produced per grind, and that are expected to lower production costs on a great many commodities, have been placed on the market by the Firth-Sterling Steel Co., McKeesport, Pa. The dies make use of inserts of Diecarb sintered carbide combinations with a Rockwell hardness of from 65 to 73, depending upon the grade. They have been tested under operating conditions in a diversified group of industrial plants for several years. Production records show from hundreds of thousands to millions of pieces produced without a regrind. The Diecarb insert punch and die shown in the accompanying illustration used for blanking 0.025-inch silicon electrical sheet stock for rotor and stator laminations averages between fifty million and sixty million pieces per grind.

Diecarb dies are available in four grades for blanking and piercing dies. These four grades are intended for punches and dies as follows: (1) For paper blanking and notching; (2) for blanking carbon-steel strip up to 3/32 inch thick; (3) for blanking and punching material up to 7/16 inch thick; and (4) for blanking materials over 7/16 inch thick. 90

Kennametal Lathe File

A new lathe file made of Kennametal having the advantages of previous Kennametal files, but which has a longer filing surface, provision for quick, easy blade replacement, and improved handling characteristics, has just been placed on the market by Kennametal, Inc., Latrobe, Pa. The Kennametal blanks of this file have brazed-on nuts, and are attached to the light-weight aluminum-alloy handle by screws. They can, therefore, be readily replaced when worn out. Two types of blanks, one with fine teeth (thirty teeth per inch) and one with coarse teeth (twenty teeth per inch) are interchangeable on the same handle.

Kennametal Lathe File and Interchangeable File Sections

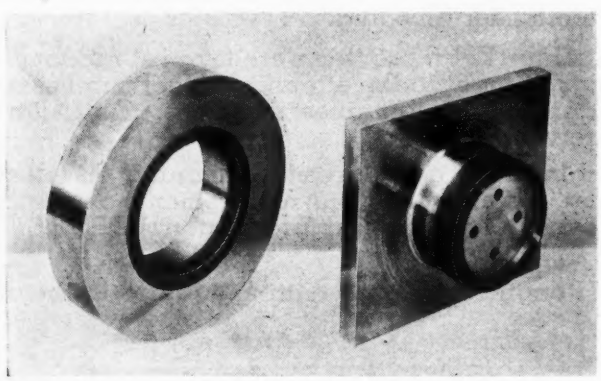
The grip or handle is shaped to fit the hand and has a thumb-rest and knuckle-guard. An extension beyond the filing surface provides an additional holding surface. This file is now available in the F-45 size, which is 13 1/2 inches long over all, and has a filing surface 3/4 inch wide by 8 inches long comprising two 3/4- by 4-inch Kennametal blanks. 91

"Ball Bushing" for Reciprocating Mechanisms

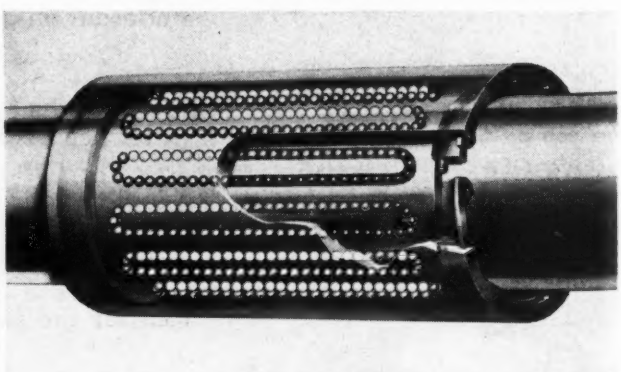
The Thriftmaster Products Division of Thomson Industries, Inc., 29-05 Review Ave., Long Island City 1, N. Y., has developed a ball bushing that permits unlimited travel of reciprocating mechanical members, which may be either round or square, or of various other shapes. The advantages gained from the use of ball bearings for rotating parts can thus be obtained for sliding members.

Basically, the ball bushing contains within it a series of ball and continuous groove circuits like the ones shown in the illustration. One side of the circuit or line of balls carries the bearing load, while the other side serves to return the balls in a clearance space provided in the outer race member of the bushing. Exceptionally free movement is said to be obtained by this friction-eliminating arrangement. The continuous bearing prevents twisting or binding on the shaft, as the bearing balls remain constantly centered under load. Rolling contact plus sealed-in lubrication gives the bearings long life combined with precision alignment.

The system of ball circuits can be varied to suit load capacities and shapes of bearing members; thus it



Blanking Punch and Die with Diecarb Inserts Made by Firth-Sterling Steel Co.



Thriftmaster "Ball Bushing" Designed to Permit Unlimited Travel for Reciprocating Members

To obtain additional information on equipment described on this page, see lower part of page 196.

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"Save thousands" **is no catch phrase—The rust preventives detailed in this lavishly illustrated, comprehensive, 40-page booklet have helped salvage literally thousands of dollars from the billion-dollar loss each year to *Demon Rust*.**

Every man who has anything to do with metals will find this booklet most instructive. Write for free copy to: Shell Oil Co., Inc., 50 West 50th Street, New York 20, N. Y. or 100 Bush Street, San Francisco 6, Calif.

SHELL

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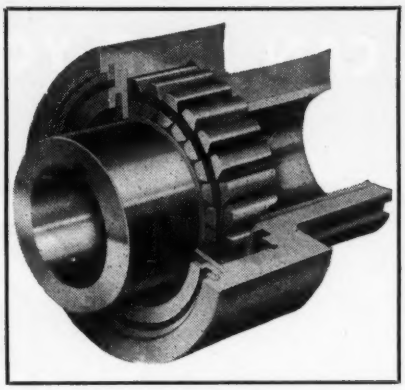
is possible to have a bearing of considerable length or of a square, hexagonal, or octagonal section. This longitudinal ball bearing has been under development for several years, and is to be identified by the trade name "Ball Bushing."-----92

South Bend Lathe

The most recent addition to the line built by the South Bend Lathe Works, 383 E. Madison St., South Bend 22, Ind., is a 9-inch precision bench lathe of the type shown in the illustration. This lathe is made especially for use where a V-belt drive is preferred. It has four-step V-belt cone pulleys which, with the back-gears, provide either eight or sixteen spindle speeds ranging from 46 to 1176 R.P.M. It is made with either quick-change gear or plain change-gear equipment for a wide range of thread-cutting and power longitudinal feeds. Two of the models are now being equipped with power cross-feeds.

All models have a 9 1/4-inch swing over the bed and saddle wings, and a 3/4-inch headstock spindle hole with maximum collet capacity of 1/2 inch. Choice of bed lengths provides for maximum distances between centers up to 34 inches. The usual line of South Bend attachments is available for use in handling special classes of lathe work.

This lathe is especially adapted for precision tool-room or production work and for general use in machine, laboratory, and repair shops for machining metals, plastics, and other machinable materials and compositions. -----93



"Formsprag" Clutch Made by Gear Grinding Machine Co.

"Formsprag" Over-Running Clutch

A new over-running clutch consisting of cylindrical inner and outer races with the annular space between them filled with accurately formed "sprags," as shown in the illustration, has been brought out by the Gear Grinding Machine Co., 3901 Christopher Ave., Detroit 11, Mich. Contact with the surfaces of the inner and outer races is maintained by an actuating annular spring at each end of the sprags. When torque is applied to the shaft, all sprags are rotated at the same time and are caused to grip both the inner and outer races to form a driving member comparable to a solid collar or shaft.

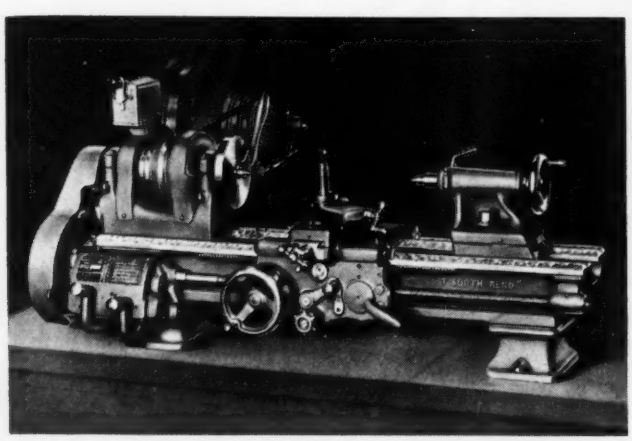
Once the torque is removed, all sprags release their grip instantaneously. Positive engagement and disengagement can be accomplished hundreds of times per minute. The large number of sprags serves to reduce localized stress to a minimum and distributes wear evenly over all contacting surfaces.

The torque-carrying capacity of this clutch is, in general, equal to that of any shaft having a diameter smaller than that of the inner race. The simple design has been worked out to obtain the maximum torque capacity for the size and weight of the clutch. -----94

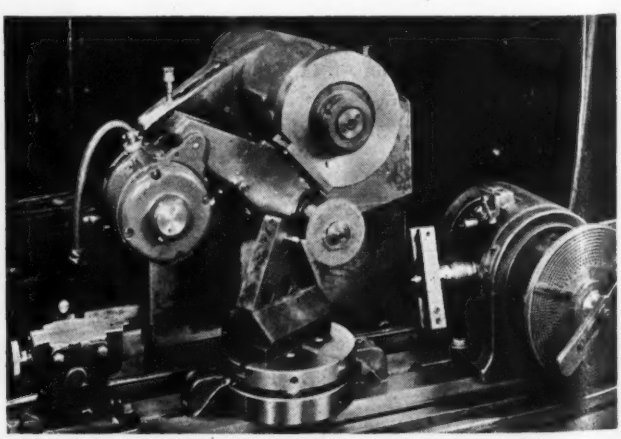
Zagar Angle-Dresser for Grinding Wheels

An angle-dresser for grinding wheels, which can be mounted in the correct center-line relation with the work and need not be removed for each dressing of the wheel, has been placed on the market by Zagar Tool, Inc., 23880 Lakeland Blvd., Cleveland 17, Ohio. The accompanying illustration shows the dresser mounted on a Brown & Sharpe grinder equipped with a Dumore grinding attachment. The dresser is shown with the right-angle plate which guides the truing diamond block set at the correct angle for dressing the wheel to the required form. With this arrangement, the block that holds the truing diamond can be quickly removed from the guiding plate to provide ample clearance space for the work when it is mounted between the tailstock and dividing head centers.

The diamond is moved by hand across the face of the wheel in performing the wheel-dressing operation. The dressing angle is obtained through the usual Zagar indexing method, and the setting can be changed for any angle required. By using an index-plate instead of the visual scale, any angle can be easily and quickly duplicated by the dresser. -----95



South Bend Precision Bench Lathe

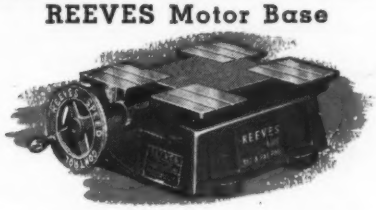


Zagar Dresser for Grinding Wheels

To obtain additional information on equipment described on this page, see lower part of page 196.

How to convert any standard constant speed motor to a Low Cost *Stepless Variable Speed Drive*

1 **Mount Your Motor on This REEVES Motor Base**

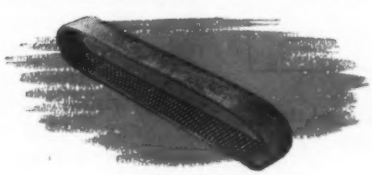


Base is built in wide range of sizes to fit any standard constant speed motor up to 15 h.p. Includes sliding platform and handwheel for moving motor forward or back.

2 **Apply This Disc Assembly to Motor Shaft**

Assembly consists of two facing cone-shaped discs, one stationary, the other sliding laterally, and compression spring for mounting on extension shaft of motor.

3 **Connect to Driven Machine With This Special V-Belt**



Place specially designed REEVES V-belt between discs and over pulley on power input shaft of the driven machine. Adjust belt to minimum center. Anchor motor base.

. . . and you have a

REEVES Vari-Speed Motor Pulley

available in sizes to 15 h.p. for stepless speed adjustability within 4:1 range.

HOW IT WORKS: The operation of a REEVES Motor Pulley is extremely simple—yet it follows the time-tested REEVES principle of a V-belt traveling between the adjustable driving diameters of cone-shaped discs. By turning handwheel, motor is moved forward or back on base, varying the driving diameters of the discs. As motor is moved toward driven machine, belt rides higher between discs, thus increasing the speed transmitted. Turning handwheel in opposite direction reverses the operation. Any speed within range is accurately maintained.

WHAT YOU CAN DO WITH IT: The REEVES Motor Pulley is the simplest dependable method of providing infinitely variable speed adjustability to a driven machine. With this low-cost, easy-to-install equipment you can transform a machine with fixed speeds into a far more versatile production unit—one that is instantly responsive to every changing condition and work schedule. Install REEVES Motor Pulleys on your machines in service, and when you buy a new machine, look for the familiar REEVES handwheel that signifies REEVES-equipped.

SEND FOR THIS CATALOG

New, 96-page book gives complete information on this and the two other basic REEVES Speed Control units—the Variable Speed Transmission and the Motodrive. Ask for Catalog M-450.

REEVES PULLEY COMPANY, COLUMBUS, INDIANA

Recognized Leader in the Specialized Field of Speed Control Engineering

Accurate Variable

REEVES Speed Control

Gives the Right Speed for Every Job!

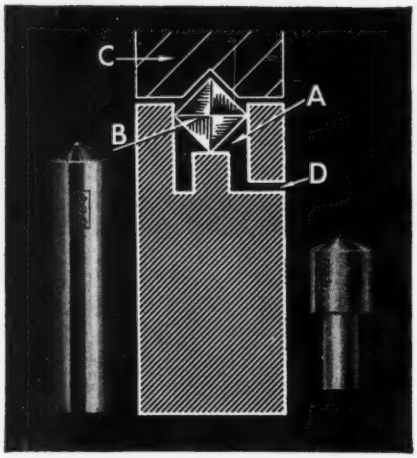


Diagram Showing Castweld Method of Setting Truing Diamond B in Holder

"Castweld" Set Industrial Diamonds

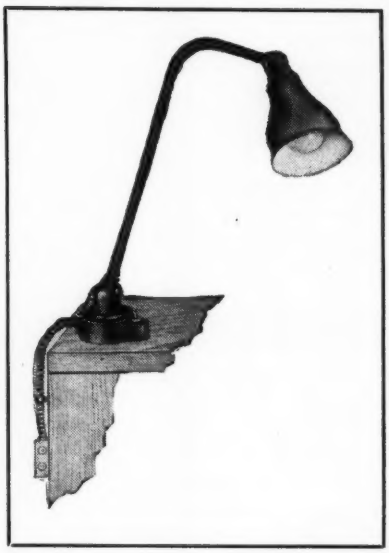
The recently patented "Castweld" method of setting industrial diamonds to insure longer life is employed in the manufacture of a full line of standard tools just brought out by the Precision Diamond Tool Co., 102 S. Grove Ave., Elgin, Ill. The Castweld method of setting industrial diamonds consists of boring the shank of the tool, as shown in the illustration at *A*, holding the diamond in a predetermined position, as indicated at *B*, while the shank is heated to the proper temperature and brazing metal is forced under pressure into the cavity through flow hole *D*. Special tools made by this process can also be furnished to suit the user's requirements.

Diamonds mounted in this manner are protected from a sudden change in temperature, as when the diamond at room temperature is suddenly plunged into molten metal. This method also avoids open flame heating of the diamond during the setting operation, and provides a solid matrix around it which is free from air holes. Accurate setting of the diamond is insured, because it is positioned before heat or brazing metal is applied. 96

Swivelier Grounded "Work-Lites"

An improved type of "Work-Lite" for attachment to machine tools, assembly benches, desks, etc., has been placed on the market by the Swivelier Co., 30 Irving Place, New York 3, N. Y. In place of the usual cord and cap used on other types of lights made by this company, the new unit comes with Greenfield cable and leads for direct attachment to the outlet box or transformer, thus "grounding" the entire unit.

This light is made with the universal, adjustable, spring construction Swivelier socket, and is available with arms from 12 to 30 inches long. It can be furnished with four types of shades—cone, bell, parabola, or acorn, and with or without removable glass lens of frosted, clear, or daylight type. 97



Swivelier Grounded "Work-Lite" for Machine Tools

* * *

Speedy Reconversion Will Help Prevent Inflation

The speeding up of reconversion to civilian manufacture, now that war production demands have been filled, is of the greatest importance for many reasons. First and foremost, of course, is the prevention or minimizing of unemployment during the reconversion period. But there are great advantages to be gained in other directions as well. Speedy resumption of civilian goods manufacture will help to prevent inflation. As long as there is a scarcity of goods, there is always the danger of inflation. As soon as civilian goods are available in sufficient quantities to meet the demands of the public, the threat of inflation will have passed.

The Railroad—A Stepchild of Government

In a recent address, F. J. Wall, vice-president of the New York, New Haven & Hartford Railroad, had this to say with regard to our different transportation systems:

"The different forms of transportation are not performing the service for which they are best fitted, because much of the water, highway, and air transportation now being operated is only possible when the waterways, highways, and airways are provided by the Government at the expense of the taxpayers.

"During the past twenty-five years, the federal, state, and local governments have spent billions upon billions of dollars to build waterways, highways, and airways to compete with the railroads. This tremendous investment pays no taxes and contributes nothing for the support of government; rather, it is costing the taxpayers an average of $2,000,000,000 per year to maintain and operate these transportation facilities.

"In comparison, the American railroads are spending an average of $1,325,000,000 each year to build and maintain their own roadways, including the taxes on the roadways, which average $340,000,000 per year. Just so long as these conditions exist, it will never be possible for the different forms of transportation to function together efficiently to provide coordinated transportation.

"This country cannot get along without the railroads, but the Government can continue to maintain and even expand water, highway, and air transportation through the expenditure of the taxpayers' money, so that it will be difficult, if not impossible, for the railroads to function as a private enterprise."

* * *

Meehanite Permanent Molds

It has been found that Meehanite cast iron is a most satisfactory material for permanent molds for casting magnesium bomb bodies. This would indicate that it would also be a satisfactory material for permanent molds for making magnesium castings in general. The mold life ranges from two to three months of steady production.

To obtain additional information on equipment described on this page, see lower part of page 196.

J & L COLD DRAWN

SQUARES • ROUNDS HEXAGONS • FLATS

Cold drawn and bright finished, accurate to size, with qualities and properties that save you money in the machining and manufacture of parts and products. Our metallurgical engineers will be glad to discuss your production problems with you.

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News of the Industry

Illinois

W. F. ELDER, who was formerly in the Master Mechanics Division at the Dodge Chicago plant of the Chrysler Corporation, and previously with the International Harvester Co. as tool designer, is now associated with the sales department of Marshall & Huschart Machinery Co., 571 W. Washington Blvd., Chicago, Ill. ELMER H. JAEGER is now also associated with the Marshall & Huschart organization; he will cover the Rockford territory in conjunction with E. V. WENZELL.

PARAGON SPRING CO., 4615 W. Fulton St., Chicago 44, Ill., has been organized by HARRY C. FAUST and CHRISTIE W. HOHE to manufacture coil springs for all mechanical purposes, small flat springs, and wire forms. Both of the founders have been identified with the spring industry for many years, Mr. Faust as chief engineer and metallurgist of the Chicago Coil Spring Co., and Mr. Hohe as general factory superintendent of the same company.

ERNST J. UTZ has been appointed district representative and project field engineer for A. W. Hecker Co., Cleveland, Ohio, engineers and builders of special machinery and production tools. Mr. Utz will have offices at 332 S. Michigan Ave., Chicago, Ill., and will cover Illinois, Wisconsin, Indiana, Minnesota, and Michigan.

STOW MFG. CO., Binghamton, N. Y., manufacturer of flexible shafts, has opened a branch office at 308 W. Washington Ave., Chicago, Ill. RALPH E. WIMMER, who has represented the company in the Middle West for a number of years, will be in charge of the new office.

TYSON BEARING CORPORATION, Massillon, Ohio, manufacturer of tapered roller bearings, has appointed the BORG-WARNER INTERNATIONAL CORPORATION, Chicago, Ill., sales representative of the company in all export markets except Canada and Alaska.

E. R. HAAN has been appointed director of advertising of the DoAll Co., Des Plaines, Ill. He was for many years technical editor of *Popular Mechanics*. With the DoAll Co., Mr. Haan will devote himself to promotional activities in the machine tool field.

MAGNA TOOL AND DIE WORKS have been moved to new quarters at 1742 Milwaukee Ave., Chicago 47, Ill., in a plant with greater capacity to handle the business of the organization.

Indiana

H. F. R. WEBER has been made divisional sales manager of silent chain drives for the Link-Belt Co., with headquarters at the company's Ewart plant, Indianapolis, Ind. Mr. Weber has been with the Link-Belt Co. for the past thirty years. A. C. FELLINGER has been appointed sales manager of power transmission machinery for the company. He will fill the vacancy caused by the death of C. Walter Spalding. Mr. Fellinger will also make his headquarters at the Ewart plant.

W. W. GLEESON has been elected president of the L. G. S. Spring Clutch Corporation, Indianapolis, Ind., a subsidiary of the Curtiss-Wright Corporation. G. W. VAUGHAN, formerly president, has been named chairman of the board, a newly created office. Mr. Gleeson was previously vice-president and general manager. The clutch firm has recently purchased the three-story Mars Hill plant in Indianapolis operated by the Allison Division of General Motors.

FRED W. GILCHRIST has been appointed manager of the Indianapolis, Ind., office of Cutler-Hammer, Inc., Milwaukee, Wis., manufacturer of electric control apparatus.

Michigan

GEOMETRIC TOOL CO., New Haven 15, Conn., has appointed the following distributors in the state of Michigan: B-H TOOL & SUPPLY CO., 5535 Woodward Ave., C. L. GRANSDEN & Co., 1214 Eighteenth St., and the RAYL CO., 228 W. Congress St.—all of Detroit; GRANSDEN-HALL & Co., 920 Walnut St., Flint; GRAND RAPIDS SUPPLY CO., 405 Grandville Ave. S. W., Grand Rapids; C. E. HAMLIN & Co., 225 N. Jackson St., Jackson; HOOVER SUPPLY CO., 416 E. Ransom St., Kalamazoo; PRECISION TOOL & SUPPLY CO., 610 E. Grand Ave., Lansing; CUTTING TOOLS & SUPPLY CO., 244 E. Pike St., Pontiac; and PORT HURON EQUIPMENT CO., 715 River St., Port Huron, Mich.

J. J. KRAUS has been appointed sales vice-president of Detroit Seamless Steel Tubes Co., Detroit 8, Mich., succeeding C. H. HOBBS, who has resigned. Mr. Kraus, who has been in the armed services since 1942, was released from active military duty in July. Before going into the service, he was attached to the Detroit office of the Sharon Steel Corporation.

C. S. GODDARD, after twenty-seven years of service as general sales manager of Goddard & Goddard Co., Detroit 23, Mich., has resigned from that position and is removing his residence to the West Coast, where he still will be connected with the company. STANLEY H. GRATTAN has succeeded him as general sales manager.

C. C. HERMANN, Detroit, Mich., has resigned as general manager of the Claude B. Schneible Co., and is planning to act as consulting mechanical engineer, specializing in foundry design and dust control. He has had over twenty-five years engineering experience in foundry design, mechanical handling in foundries, and dust collection.

MOORE PRODUCTS CO., Philadelphia 24, Pa., has opened a branch office in the Penobscot Bldg., Detroit, Mich., to serve Michigan, southern Ontario and northern Ohio. J. E. GAMBRILL is in charge of sales and service on both "Nullmatic" industrial instruments and Moore pneumatic comparator gages.

FOSTER R. WOODWARD, recently associated with the Westinghouse Electric Corporation in the capacity of welding engineer, has joined the staff of the Progressive Welder Co., 3050 E. Outer Drive, Detroit 12, Mich., as welding applications engineer.

EDWARD B. MCENTEE, 17115 Hillsboro Road, Cleveland 12, Ohio, has been appointed MACHINERY'S field representative for the sale of subscriptions and books in the Michigan, Indiana, and Ohio territory formerly served by DEWITT D. LEWIS.

LEAR, INC., manufacturer of power units and actuators for linear and rotary motion, has moved its executive offices and accounting departments from Piqua, Ohio, to 110 N. Ionia Ave. N. W., Grand Rapids 2, Mich.

DOW CHEMICAL CO., Midland, Mich., has leased a portion of the Defense Plant Corporation's plant at Ludington, Mich., which will be used for producing lime and magnesium chloride liquor.

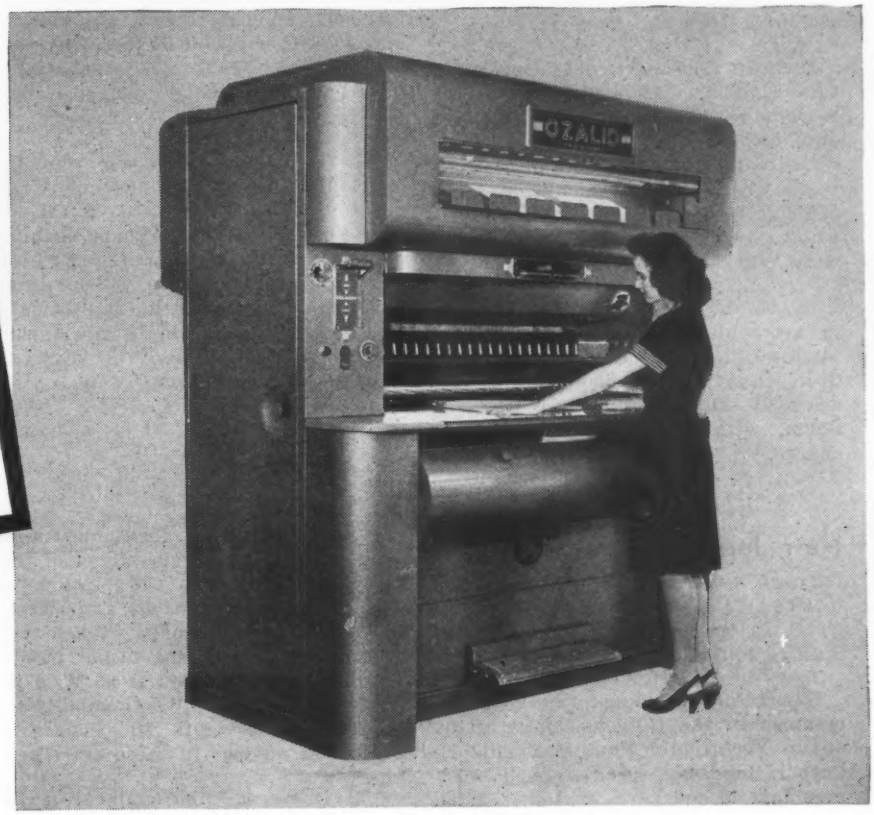
New England

EDWARD VAN DER PYL has been appointed superintendent of the Norbide plant of the Norton Co., Worcester, Mass. He has been with the company for thirty years, and recently has been specializing in development work on Norbide and diamond products. The increased demand for Norbide products, such as lapping abrasive, pressure blast

New! The OZALID PRINTMASTER

...Does the work of any two other printmaking machines!

- ✓ 22 features save time, labor, money!
- ✓ Makes "impossible" orders easy to fill!
- ✓ One operator does the work of three!
- ✓ Automatically stacks originals and prints!
- ✓ Makes all 10 types of Ozalid prints in seconds!



To Reproduce your engineering drawings, operation sheets, typed reports, and other material . . . you may be using two, three, or more printmaking machines.

Even so, you are probably *not* equalling the volume you could turn out with ONE Ozalid Printmaster and ONE operator!

The OZALID Printmaster provides speed, flexibility, and versatility never before available for large-volume printmaking. It makes "impossible" orders easy to fill. It simplifies the operator's job with automatic controls that set new standards for dependability. And it allows you to utilize fully the versatility that *only* the Ozalid Process affords!

All 10 Types of Ozalid prints (on paper, cloth, foil, or film) are made *in seconds* with the *Printmaster*. There are just two steps, both automatic: Exposure, and *Dry* Development. To make a black-line, blue-line, or red-line paper print from an average pencil tracing takes only *7 seconds*. An ink tracing reproduces even faster. Beautiful Ozalid *Dryphotos*—continuous-tone *photographic* prints—take only a few seconds longer!

One Operator easily does the work of three . . . as all controls are automatic or require only "finger-tip" attention.

Both your originals and your finished prints are AUTOMATICALLY *returned* and *stacked* in correct order! The prints can be stacked either in the front or the rear receiving tray—and the *change* from front to rear can be made instantly!

Ozalid Electronic Speed Control permits instant shifting to any speed between zero and 30 feet per minute.

Altogether, there are 22 new design features for more efficient operation!

The Saving in Time and Labor alone will soon "write off" the cost of *your* Ozalid *Printmaster* . . . and then go on to pay dividends for years.

Maintenance requirements are few . . . and if your floor space is at a premium, the *Printmaster* can help—it requires *only 18 square feet*.

In addition to reducing your present printmaking costs, you'll find that the *Printmaster* will extend your use of prints to all departments . . . allowing you to establish new and more economical routines, and do jobs you never considered within the scope of technical reproduction equipment.

SEND FOR THE FREE *"OZALID PRINTMASTER BOOKLET"*—containing samples of the 10 different types of prints you can make.

OZALID

DIVISION OF GENERAL ANILINE AND FILM CORPORATION • JOHNSON CITY, N. Y.

OZALID IN CANADA—HUGHES-OWENS CO., LTD., MONTREAL

nozzles, gage blanks, and metallurgical compound, has resulted in the establishment of a separate plant for their production at Worcester.

FEDERAL PRODUCTS CORPORATION, 1144 Eddy St., Providence 1, R. I., manufacturer of precision measuring instruments, has set up a field engineering service department to cooperate with the users of Federal instruments. Field service men will cooperate with users through the local representatives of the company. Their services are available upon request.

HARVILL CORPORATION, 6251 W. Century Blvd., Los Angeles 43, Calif., has established a branch plant at Jefferson and Lawton St., Fall River, Mass., which will handle all types of die casting, finishing, and machining. The HARVILL NEW ENGLAND CORPORATION, a wholly owned subsidiary of the company, will operate the branch.

ALFRED B. KING & CO., distributors of arc-welders and welding supplies for the Lincoln Electric Co., Cleveland, Ohio, announce the opening of a new office at 211 State St., Bridgeport, Conn., with HOWARD PENNINGTON in charge.

New Jersey

JAMES S. WILSON has been advanced by the Watson-Stillman Co., Roselle, N. J., to the position of manager of plastics equipment sales.

HARRY A. FELDBUSH, formerly works manager of the Holyoke, Mass., plant of the Worthington Pump & Machinery Corporation, has been named vice-president in charge of engineering for the entire corporation. He will make his headquarters at the general offices, Harrison, N. J.

Harry A. Feldbush, Vice-President in Charge of Engineering for Worthington Pump and Machinery Corp.

HOBART C. RAMSEY, executive vice-president of the Worthington Pump & Machinery Corporation, has, in addition to this office, assumed that of president of the Ransome Machinery Co., Dunellen, N. J., a subsidiary of the Worthington organization. J. G. TEN EYCK has been made vice-president and general manager of the Dunellen plant. KENNETH W. HORSMAN, formerly superintendent of welding and steel fabrication of the Worthington Harrison Works, has been transferred to the Ransome plant as works manager.

WHEEL TRUEING TOOL CO., Detroit, Mich., announces that the company has purchased the ADAMANT TOOL CO., of Bloomfield, N. J. The purchase includes plant, equipment, good will, and manufacturing processes. The personnel of the Adamant organization will remain the same, but the business will be conducted under the name of the ADAMANT TOOL CO., EASTERN DIVISION OF WHEEL TRUEING TOOL CO.

New York

G. EDWARD PENDRAY, for the last nine years assistant to the president of the Westinghouse Electric Corporation, in charge of public relations and education, has opened an office of his own as counselor in management, public relations, and education at 55 W. 47th St., New York. The Westinghouse organization will retain Mr. Pendray's services as advisor in these activities.

J. H. DEPPELER, chief engineer of the Metal and Thermit Corporation, New York, N. Y., has been selected by the American Welding Society to be the recipient of the Miller Award for outstanding work contributing to the art of welding. Established in 1927 by S. W. Miller, the award is granted annually by this Society.

JOHN C. SYKORA has been elected vice-president and director of sales for all divisions of the Portable Products Corporation, Pittsburgh, Pa. Mr. Sykora will direct his work from the newly established headquarters of the organization in the Woolworth Bldg., New York City.

RICHARD O. LOENGARD has been elected president of United Chromium, Inc., New York City. THEODORE G. COYLE and HUGH D. MCLEESE have been elected vice-presidents. All three have been associated with the organization since its inception. Mr. Coyle will continue as technical director, and Mr. McLeese as general sales manager. A new plant is now being equipped at Carteret, N. J., for the manufacture and development of the company's products, in addition to the laboratories and offices maintained at Detroit, Mich., and Waterbury, Conn.

Richard O. Loengard, Recently Elected President of United Chromium, Inc.

BENDIX AVIATION CORPORATION, 30 Rockefeller Plaza, New York 20, N. Y., announces the formation of a new division, known as BENDIX INTERNATIONAL, to handle the foreign trade of the corporation. CHARLES T. ZAORAL will be general manager of the new division.

BARDWELL & MCALISTER, INC., Hollywood, Calif., manufacturers of the Rosan locking system for threaded inserts and studs, have appointed R. B. FERRIS, Syracuse, N. Y., agent for Rosan fastening units. He will cover New York State and New England.

J. GORDON LIPPINCOTT & CO., 500 Fifth Ave., New York 18, N. Y., industrial designers, have added a Client Relations Division to the organization, with DON JORDAN, formerly of Jordanoff Aviation Corporation, New York, as division director.

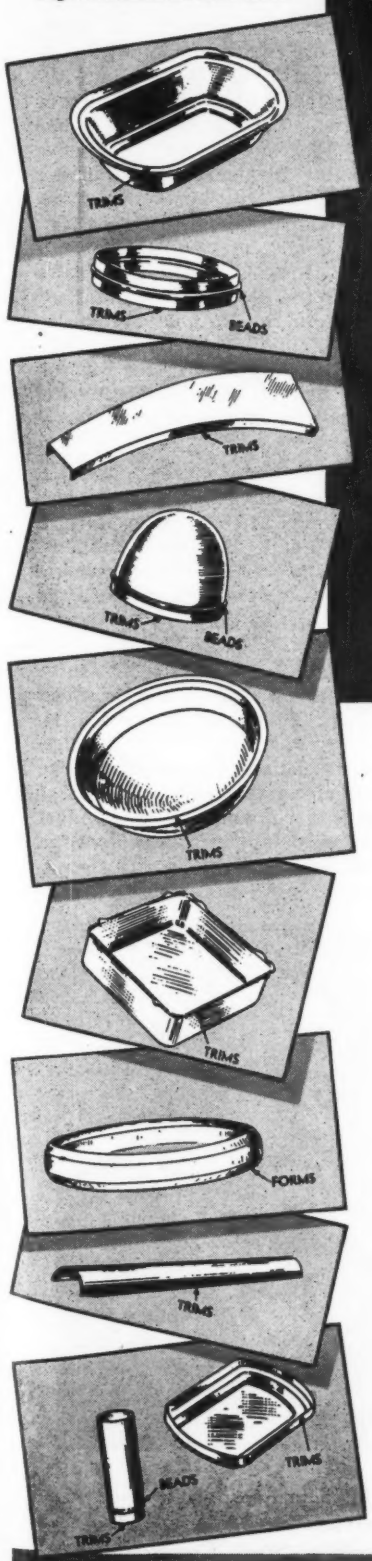
CLEVELAND PNEUMATIC TOOL CO., Cleveland, Ohio, announces the formation of a Railway Division, with eastern headquarters at 50 Church St., New York City. JOHN N. THORP will be the new division's representative.

FRANKLIN A. REED has been appointed sales manager of the Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo 11, N. Y. He succeeds GEORGE R. KINNEY, who resigned on August 1.

CARPENTER STEEL CO., Reading, Pa., has opened a new warehouse and office at 79 Greenwich St., New York City, under the supervision of R. P. EVANS.

Do you know that one simple machine TRIMS • FORMS • BEADS • FLANGES Stampings of any size or shape

Shearing action of Quickwork stamping trimmer leaves all edges clean and free from burrs.



In the first four months of operation the stamping trimmer shown above, working 16 hours a day, trimmed over 500,000 of these 14-gauge stampings —accurately to ±.003". THERE WERE NO REJECTS.

Here's a machine that cuts production time on all types of stampings

Quickwork stamping trimmers, specially adapted to each particular job, handle almost any type of stamping in a single plane—trimming, forming, beading, or flanging large or small stampings with or without flash, and cutting steel, aluminum alloy, and stainless steel with ease. With the Quickwork, these operations are reduced to seconds.

Quickwork stamping trimmers save valuable press time, eliminate the need for expensive trimming dies. Check their possibilities for removing your production bottlenecks; write for Bulletin QW-119.

QUICKWORK DIVISION

WHITING CORPORATION

15673 LATHROP AVENUE, HARVEY, ILLINOIS

PAUL KOFMEHL has been appointed mechanical engineer with Salkover Metal Processing, Long Island City, N.Y.

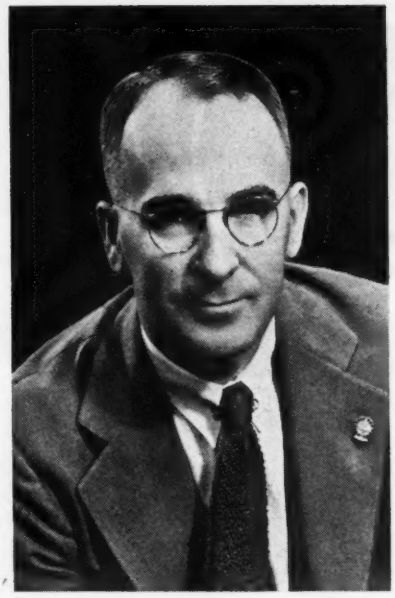
Ohio

ARO EQUIPMENT CORPORATION, Bryan, Ohio, has appointed the following companies to handle its line of industrial pneumatic tools: C. S. KEGERREIS SUPPLY, INC., Elkhart, Ind.; WESTERN IRON STORES CO., Milwaukee, Wis.; GENERAL SUPPLY CO., Kansas City, Mo.; and OVERTON & ROSS, INC., Wichita Falls, Tex.

STANLEY E. JOHNSON, general sales manager of the Cooper-Bessemer Corporation, Mount Vernon, Ohio, has been elected a vice-president and a member of the board of directors. CHARLES G. COOPER, manager of the company's Washington office, has also been elected a member of the board.

GILBERT SOLER, superintendent of the quality control departments of the Steel and Tube Division of the Timken Roller Bearing Co., Canton 6, Ohio, has been made assistant general superintendent of that division. Mr. Soler has been connected with the organization since 1931.

S. B. TAYLOR has been elected president of the Parker Appliance Co., 17325 Euclid Ave., Cleveland, Ohio, manufacturer of aircraft and industrial valves and fittings, succeeding H. I. MARKHAM, who was recently advanced to the position of chairman of the board. Mr. Taylor was also elected a director. Previous to joining the company, he was manufacturing vice-president of the Reliance Electric & Engineering Co.



Fred E. Harrell, General Works Manager, Reliance Electric & Engineering Co.

FRED E. HARRELL, chief engineer of the Reliance Electric & Engineering Co., Cleveland, Ohio, for the last two years, has been appointed general works manager, succeeding S. B. TAYLOR, who has resigned as manufacturing vice-president, but who will remain a member of the board of directors. WILLIAM R. HOUGH, product development engineer, has been made chief engineer, succeeding Mr. Harrell. Mr. Harrell has been with the Reliance organization since 1924, when he graduated from Purdue University. Mr. Hough has been with the organization since 1929, when he graduated from the University of Michigan.

C. H. REYNOLDS, vice-president of the Sheffield Corporation, Dayton, Ohio, has been selected by the War Department as a member of a group of American businessmen who are inspecting industrial plants in Germany and other European countries. Mr. Reynolds was chosen for this assignment because of his broad knowledge of engineering and manufacturing processes.

OSBORN MFG. CO., Cleveland, Ohio, announces the establishment of an export department in its Molding Machine Division, with WARD DOUGHERTY as export manager. Mr. Dougherty has been with the company for twenty-five years, having formerly been manager of the Machine Division contract department.

RALPH R. ROOT has been made sales manager of the electrical manufacturing division of the National Acme Co., Cleveland 8, Ohio. This division manufactures the "Chronolog," for controlling idle time of machine tools, and other electrical equipment.

EARL A. TAYLOR has been appointed general works manager of the Automotive Division of the Crosley Corporation, Cincinnati 25, Ohio. He formerly held the position of works manager of the Detroit plant of the Hudson Motor Car Co.

N. J. CLARKE has been elected senior vice-president of the Republic Steel Corporation, Cleveland, Ohio, and J. M. SCHLENDORF has been elected vice-president in charge of sales. Mr. Clarke has been vice-president in charge of sales since 1930, and Mr. Schlendorf has been assistant vice-president in charge of sales since 1936.

S. B. Taylor, Recently Elected President of the Parker Appliance Co.

N. J. Clarke, Senior Vice-President of the Republic Steel Corporation

J. M. Schlendorf, New Vice-President in Charge of Sales, Republic Steel Corporation

Charles H. Saiter, Sales Manager, Heavy Machine Division, Cleveland Crane & Engineering Co.

CLEVELAND CRANE & ENGINEERING CO., Wickliffe, Ohio, has established a new sales division known as the Heavy Machine Division, with headquarters in Wickliffe. The division will be responsible for the sales of heavy Cleveland overhead traveling cranes and Steelweld bending presses, bulldozers, and special machinery. CHARLES H. SAITER has been appointed sales manager in charge of the new division.

F. J. VAN POPPELEN has been appointed vice-president of the Salem Engineering Co., Salem, Ohio. Mr. Van Poppelen was formerly chief engineer of the Military Division of the Remington Arms Co., Bridgeport, Conn.

HERMAN MACHINE & TOOL CO., Tallmadge, Ohio, has doubled its heat-treating capacity and expanded its facilities for carburizing by 50 per cent, in order to be in a position to handle greater production.

Pennsylvania

HARRY R. MICHAELS and CHARLES R. STEVENS, both veteran employes of the East Pittsburgh Works of the Westinghouse Electric Corporation, have been presented with the Order of Merit, the highest honor bestowed upon its employes by the corporation for distinguished service to the electrical industry. Mr. Michaels joined the Westinghouse organization forty-four years ago, and has been a foreman in the metal stamping department for nearly three decades. He received the award for his development and improvement in the design of metal stamping dies. Mr. Stevens became connected with the Westinghouse organization in 1916, and has been purchase section supervisor for the last fourteen years. He received the award for his contributions in the field of scrap disposition and salvage of waste materials.

ROBERT H. GARDNER has been appointed general manager of sales of A. M. Byers Co., Pittsburgh, Pa. Mr. Gardner has been manager of Byers' Washington office since 1933, except for a four-year period ending in 1940, during which he was manager of the company's steel pipe sales, with headquarters in Pittsburgh.

FRANK H. GORDON, vice-president in charge of sales of the Lukens Steel Co., Coatesville, Pa., completed fifty

Frank H. Gordon, Vice-president of the Lukens Steel Co., Who has been Fifty Years with That Organization

years of continuous service with that organization on July 25. He went to work with the organization, then known as the Lukens Iron & Steel Co., in 1895. He became assistant general sales manager in 1903, and general sales manager in 1907; he was elected a vice-president in 1928.

R. D. WOOD CO. announces that the Philadelphia offices of the company are now located in the Public Ledger Bldg., Independence Square, Philadelphia 5, Pa.

LLOYD R. CLOWES, Pittsburgh district sales manager of the Firth-Sterling Steel Co., McKeesport, Pa., has been appointed assistant general sales manager of the company. For two years previous to joining the Firth-Sterling

Lloyd R. Clowes, Newly Appointed Assistant General Sales Manager, Firth-Sterling Steel Co.

Steel Co., Mr. Clowes was chief of the Cutting Tools Section, and chief of the Gage and Precision Tool Section of the War Production Board's Tool Division. For twenty-three years prior to that, he was associated with the L. S. Starrett Co.

TATE-JONES & CO., INC., manufacturers of industrial furnaces and accessory heat-treating equipment, announce the removal of their offices from Leetsdale, Pittsburgh 30, Pa., to the Plaza Bldg., Pittsburgh 19, Pa.

RICHARD W. BERG has been appointed district engineer for the Pittsburgh territory of the Bantam Bearings Divi-

Richard W. Berg, District Engineer, Bantam Bearings Division, Torrington Co.

sion of the Torrington Company, South Bend, Ind. He became connected with the company in 1944.

ACE MFG. CORPORATION, Philadelphia, Pa., has purchased the entire assets of DELLOY METALS, manufacturer of a complete line of cutting tools. The company will be operated as an affiliate of the Ace Mfg. Corporation under the name DELLOY METAL CORPORATION, Erie Ave. and K St., Philadelphia, Pa.

W. D. TURNBULL has been made general sales manager of Kennametal, Inc., Latrobe, Pa. Mr. Turnbull is a graduate of Pennsylvania State College,

W. D. Turnbull, Recently Appointed General Sales Manager, Kennametal, Inc.

and has had more than twenty-five years experience in both engineering and sales in diversified industries.

ASHDALE TESTING LABORATORIES, 97 E. Montana St., Philadelphia 19, Pa., has opened a completely equipped measuring laboratory for checking plain and thread gages, gage-blocks, taps, form tools, dies, jigs, and fixtures. Hardness tests will also be made.

VANADIUM-ALLOYS STEEL CO., Latrobe, Pa., announces the following appointments: FRANK MOBERG, works manager of Latrobe plant; HARRY GOOD, works manager of Anchor Drawn Steel Co.; DR. GEORGE A. ROBERTS, chief metallurgist; and LAWRENCE WOOD, advertising manager.

Texas and Colorado

E. L. STACEY, southern Texas representative for the Federal Products Corporation, Providence 1, R. I., manufacturer of dial indicators and dial indicator gages, has moved his office from 3022 Houston Ave., Houston 9, to 2148 Dryden Road, Houston 5, Texas.

C. D. BELT & CO., 1530 16th St., Denver, Colo., have been appointed district sales representatives for the Allen-Bradley Co., Milwaukee, Wis., manufacturer of solenoid motor controls.

West Virginia and District of Columbia

HENRY E. MACARTHUR has been appointed manager of the manufacturing and repair department at Huntington, W. Va., of the Westinghouse Electric Corporation. He has been connected with the Westinghouse organization since 1929, and previous to his present appointment was maintenance foreman of the manufacturing and repair department of the Newark plant.

CINCINNATI MILLING AND GRINDING MACHINES, INC., Cincinnati, Ohio, have removed their Washington, D. C., office from its former location at 15th and New York Ave. N.W., to 2701 Fourteenth St. N.W., Washington 9, D. C.

Wisconsin

S. C. LAWSON, formerly central divisional manager of Ampco Metal, Inc., Milwaukee 4, Wis., has been appointed assistant general sales manager in charge of field operations. PHILIP F. ERLANDSON has been appointed eastern zone manager with headquarters at Room 521, 1060 Broad St., Newark, N. J. WILLIAM J. DEMUTH has become district manager at the Newark office. W. T. PETERSON has been transferred from the Newark office to Detroit, where he becomes central zone manager with headquarters at Room 316, 4612 Woodward Ave., Detroit, Mich. The Cleveland and Pittsburgh offices are to be operated as one territory; EMIL SVOBODA will be district manager, with headquarters at Room 218, 4500 Euclid Bldg., Cleveland, Ohio.

H. B. KRAUT has resigned as president and general manager of the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., and becomes chairman of the board, in which capacity he expects to take care of numerous developments in connection with the future operations of the organization. He has been the active head of the company since 1924. His son, Lieutenant Colonel Ralph J. Kraut, who recently was released from active service in the Army, succeeds his father as president and general manager. Previous to entering the Army in 1942, he was executive vice-president of the organization.

AMPCO METAL, INC., Milwaukee 4, Wis., announces the organization of an export sales department, with FRED H. OPITZ in charge. Mr. Opitz will maintain headquarters in Milwaukee.

F. A. WRIGHT has been appointed assistant general sales manager of Cutler-Hammer, Inc., Milwaukee, Wis. Mr. Wright has been associated with the organization since 1927.

Coming Events

SEPTEMBER 10—Meeting of the New York Chapter of the AMERICAN SOCIETY OF TOOL ENGINEERS at the Hotel New Yorker, 8 P.M. J. D. Schiller, secretary, 1440 E. 14th St., Brooklyn, N. Y.

OCTOBER 2-3—Meeting of the Cincinnati section of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS to be held at the Netherland Plaza Hotel, Cincinnati, Ohio, replacing the fall meeting of the Society, which was canceled in accordance with the rulings of the Office of Defense Transportation.

NOVEMBER 26-30—Annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS in New York City. C. E. Davies, secretary, 29 W. 39th St., New York 18, N. Y.

* * *

Safety Color Code

The American Standards Association has published a new Safety Color Code for marking physical hazards. This code has been developed by one of the association's war committees. The purpose of the code is to unify, on a national scale, the color markings used to warn employes of dangers to be avoided, to mark the location of safety equipment, and to identify other protective equipment. The standard deals with suggested applications of colors for the marking of fire sirens, posts, hand-rails, unguarded edges of platforms, etc.

While this work was undertaken at the specific request of the War Department for its application in industries and warehouses connected with war work, it is anticipated that a committee will be set up to consider the approval of this standard for peacetime application, or its revision. Meanwhile, the standard should prove a valuable source of information to those charged with the safety of manufacturing plants. Copies of the American War Standard Safety Color Code for Marking Physical Hazards, Z53.1-1945, are available from the American Standards Association, 70 E. 45th St., New York 17, N. Y., at 25 cents per copy.

* * *

Production is the best insurance against inflation.

Now! an IMPROVED KENNAMETAL LATHE FILE

- *CUTS STEEL NO ORDINARY FILE CAN TOUCH*
- *PERMITS FILING SPEEDS 3 TO 10 TIMES THOSE POSSIBLE WITH STEEL FILES!*
- *OUTLASTS MILL CUT FILES 50 TO 200 TIMES*

This new Kennametal Lathe File retains all the time- and cost-saving characteristics of previous designs —*cuts steel up to 62 Rockwell C hardness; does outstanding job on cast iron and non-ferrous materials; permits filing operations at carbide tool turning speeds; produces superior finish.*

And now, in addition, it provides these new features — *longer filing surface; quick, easy blade replacement; greater handling convenience.*

The filing surface comprises two 4" long Kennametal blanks which have cylindrical nuts brazed to them, and are attached to the aluminum alloy handle by screws. After long service (up to 200 times that obtained from steel files) the blanks can be readily replaced.

The handle grip has a thumb rest and knuckle guard. An extension of the handle beyond the filing surface provides a secure finger hold. A hole in this extension permits the file to be hung up.

On the first production run, a Kennametal Lathe File usually saves its cost many times over. Order one—let it demonstrate to you an astonishingly low filing cost-per-piece.

Features

REPLACEABLE BLANKS

Kennametal blanks are attached by Phillips head screws. Two types are available: fine (30 teeth per inch); and coarse (20 teeth per inch).

LIGHT WEIGHT

Weighs less than one lb. Can be handled with ease, and used for long periods of time with minimum expenditure of energy.

HAND-FITTING GRIP

Handle is comfortable—it fits the hand; provides secure grip. Opposite end of file provides convenient finger hold.

SPECIFICATIONS AND PRICES

COMPLETE FILE		FILE BLANK—2 REQUIRED		
CAT. No.	PRICE EACH	CAT. No.	TEETH/ INCH	PRICE EACH
F-45*	$18.50	F-453	30	$7.50
		F-452	20	7.50

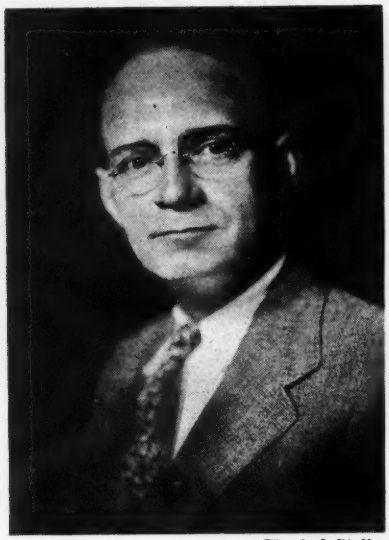
* Furnished with blanks having 30 teeth/inch unless otherwise specified.

KENNAMETAL

SUPERIOR CEMENTED CARBIDES

KENNAMETAL Inc., LATROBE, PA.

Obituaries



Blank & Stoller

William H. Bryant

William H. Bryant, Chicago sales manager of Joseph T. Ryerson & Son, Inc., died Monday morning, July 23, near Iron Mountain, Mich., at the age of fifty-four years. He had been on a leave of absence because of his health since February 26, this year.

Mr. Bryant was born in St. Louis, but spent most of his life in Chicago. He became associated with the Ryerson organization in 1906. He was well known in steel circles, and will be greatly missed by his many friends throughout the industry, who will long remember him for his intense loyalty and unfailing enthusiasm.

J. Russell Garrison

J. Russell Garrison, president and general manager of the Garrison Machine Works, Inc., Dayton, Ohio, died suddenly on July 18 at his home in Dayton. Mr. Garrison was well known in the automobile, aircraft, and machine tool industries. He was born in Dayton in 1896, and graduated with the first class in Mechanical Engineering from the University of Dayton. Shortly after his graduation, he became connected with the Ordnance Department as a civilian employe. At the close of World War I, he became associated with his father, founder of the Garrison Machine Works and the Garrison Gear Grinder Co. Here he had much to do with the development of the Garrison gear tooth grinder, which was later acquired by Pratt & Whitney. Many patents on pitch line control gear chucks were also issued to him.

Mr. Garrison was a member of the patent committee of the National Association of Manufacturers, the Army Ordnance Association, and the Engineers' Club of Dayton. He is survived by his widow, his mother, two sisters and three brothers, the latter all active in the Garrison Machine Works, Inc.

F. Archer Thompson, head of the Detroit office of the Bullard Co., Bridgeport, Conn., died on July 31 in Grace Hospital, Detroit, of a heart ailment. Mr. Thompson was sixty-two years old. He became connected with the Bullard Co. as a machine operator in 1912. Later he was made a demonstrator, and subsequently headed the firm's standards department. Following the first World War, Mr. Thompson superintended the lay-out of the present Bullard plant. He is survived by his wife, two sons, and two daughters. One son, Wilfred Thompson, his father's assistant for many years, will be in charge of the Detroit office.

Michael J. Sasgen, founder and president of both the Grand Specialties Co. and the Sasgen Derrick Co., Chicago, Ill., died on July 27, following a stroke. Mr. Sasgen was a resident of River Forest, Ill. He was born in Germany, and came to this country when a young man. Soon after his arrival, he established his own business. Mr. Sasgen was a well-known inventor and engineer, and developed many of the machines and tools manufactured by his companies. He is survived by his widow and two sons, both of whom are active in the conduct of their father's businesses.

New Books and Publications

How to Speed Up Settlement of Your Terminated War Contract. By J. K. Lasser, Certified Public Accountant. 186 pages, 8½ by 11 inches. Published by the Mc-Graw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price, $3.50.

The rules concerning termination of war contracts as given in this book are formulated from a study of the more important Government regulations issued up to the date of publication of the book. The book covers the subject very thoroughly, giving directions, forms for accounting and recording purposes, and suggestions as to procedure both before and after receiving a termination notice. It has a section on what to do about the inventory after termination and how to determine the amount due the contractor. There is also a special section for subcontractors, reviewing their problems and indicating what has been done to assist them. The book will be helpful to business executives, accountants, and others faced with the problems incident to contract termination.

Business Executive's Guide. By J. K. Lasser. 252 pages, 5 by 8 inches. Published by Whittlesey House, McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price, $3.

This book is intended to serve as a check list for business executives on problems of organization, finance, taxes, and management. It is the result of notes made during twenty years of experience on the part of the author, who is a certified public accountant, in advising executives on business problems. The book covers a very wide range of problems, from those involved in the setting up and the buying or selling of a business to such problems as controlling filing costs, collecting accounts, organizing for good employe relations, etc. A specific list of the essential points to be considered or the procedure to be followed is given for every problem included. Many concrete cost-saving suggestions are given.

Quality Manual of the Aircraft War Production Council. 188 pages, 8½ by 11 inches. Published by the Aircraft War Production Council, Inc., 7046 Hollywood Blvd., Los Angeles 28, Calif. Price, $2.92.

The purpose of this book is to provide a source of information that will promote uniformity of quality among the member aircraft companies and their sub-contractors. The book covers a great many subjects pertaining to inspection, tooling, welding, heat-treatment, finishing and processing, rivets, bolts, tubing, wooden structures, sheet-metal structures, detail assemblies, cowling, alighting gears, instruments, hydraulic systems, and armament. A limited number of copies are available from the office of the Aircraft War Production Council at the address given above.

Secrets of Industry. By Lewis C. Ord. 255 pages, 5 by 7 3/8 inches. Published by Emerson Books, Inc., 251 W. 19th St., New York 11, N. Y. Price, $3.

The author of this book, a consulting engineer and mass production expert, believes that the welfare of the public, the wealth and trade of the nation, and the future of industry itself all depend on securing maximum industrial efficiency. He has, therefore, made a careful research into industry, labor, and management, with a view to analyzing and determining

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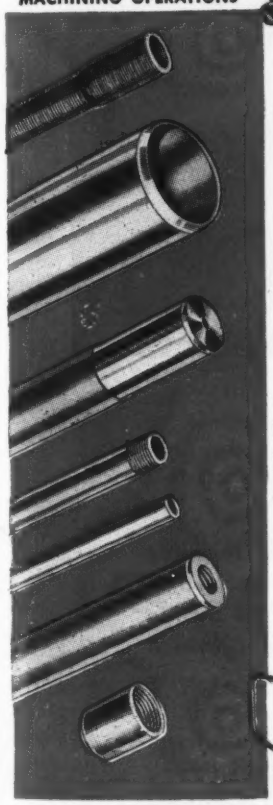

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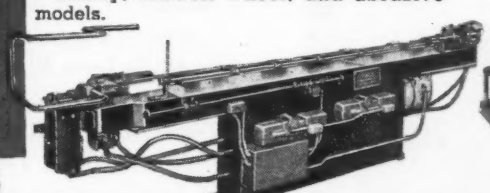

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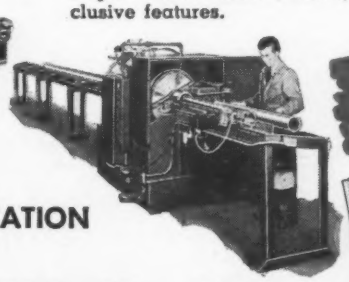

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the requirements and techniques of industrial efficiency. A comparison of industrial methods in the United States, England, Canada, Europe, and Australia is made.

STANDARD AND EMERGENCY MACHINE SHOP METHODS. By Fred H. Colvin and Frank A. Stanley. 333 pages, 5 1/2 by 8 1/2 inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price, $3.50.

This book is a manual of machine shop methods, intended to give a general idea of machine shop operations and the machines used, and to demonstrate especially how various kinds of operations can be performed on types of machines not intended for them. It contains time-saving ideas applicable to shops that handle a variety of work. For example, it shows how turning is done on a drill press, a boring machine, and a milling machine, instead of in the lathe, and many other examples of ingenious methods, taken from the experience both of larger and of very small shops that have turned out war products with improvised equipment, are included.

PRACTICAL DESIGN FOR ARC WELDING. (Volume 3). By Robert E. Kinkead. 200 pages, 8 1/2 by 11 inches. Published by Hobart Brothers Co., Troy, Ohio. Price, $3.50. (Volumes 1, 2, and 3 in a set, $10).

This is the third and final volume of Mr. Kinkead's series of books on welding design. Twenty design plates show in graphic form what not to do in designing for arc welding. They show common faults in design, with suggestions as to how they can be avoided. In another twenty plates, modern design principles are elaborated upon; and in the final twenty plates, typical patents that have been granted in connection with the welding process are outlined.

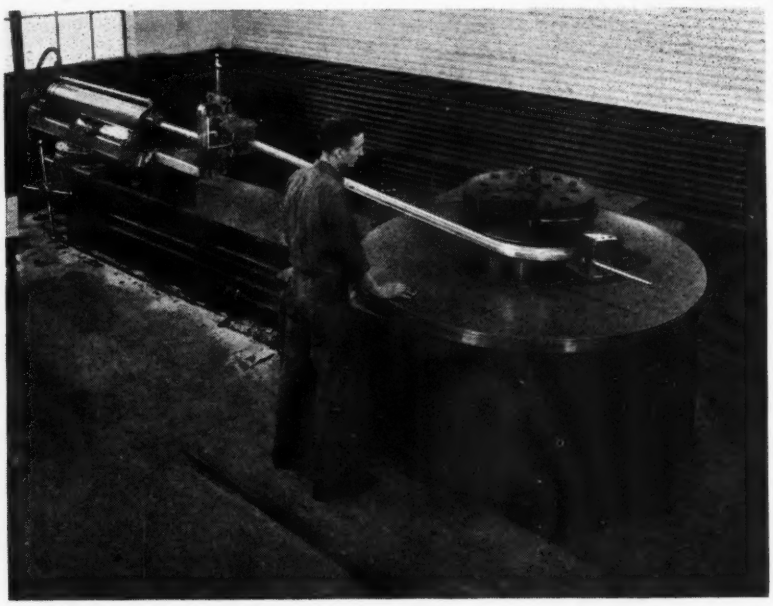
WARTIME TECHNOLOGICAL DEVELOPMENTS. 418 pages, 6 by 9 inches. Published by the Committee on Military Affairs of the United States Senate. Obtainable from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price, 50 cents.

CAST IRON IN THE CHEMICAL AND PROCESS INDUSTRIES. 28 pages. Published by the Gray Iron Founders' Society, Cleveland, Ohio. Price, $1.

This little pamphlet contains extensive data on the corrosion rates of cast iron exposed to the action of substances commonly handled by chemical structures. The text was written by F. L. LaQue, head of the corrosion engineering section of the International Nickel Co., Inc. Results of laboratory and plant tests with more than three hundred corrosive media are given.

CALCIUM METALLURGY AND TECHNOLOGY. By C. L. Mantell and Charles Hardy. 148 pages, 6 by 9 inches. Published by the Reinhold Publishing Corporation, 330 W. 42nd St., New York 18, N. Y. Price, $3.50.

STEEL EXPANSION FOR WAR. By W. A. Hauck. 191 pages, 8 1/4 by 11 inches; 148 illustrations, in addition to charts and tables. Published by the Penton Publishing Co., Cleveland 13, Ohio. Price, $2.



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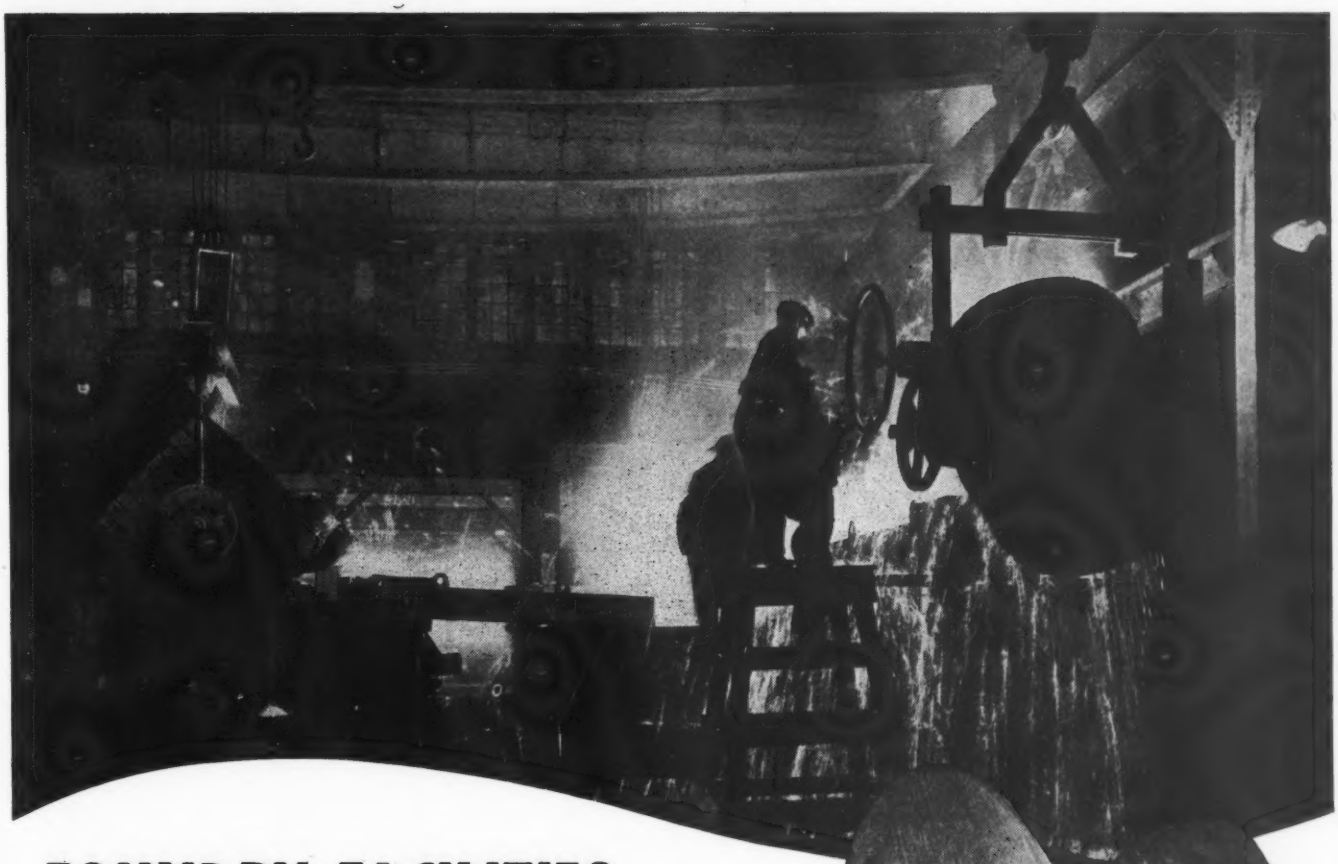

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